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ATHLETIC TRAINING
AND
HEALTH.

BY

JOHN HARRISSON.

ATHLETIC TRAINING

AND

HEALTH:

BIBLIOTHECA BODLEIANA

AN ESSAY ON PHYSICAL EDUCATION.

BY

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NOTE.

A Paper which obtained the Gold Medal of the Athletic Society of Great Britain in 1864, is incorporated with the following Essay. A few copies of the Paper were printed and circulated at that time.

J. H.

Congleton, March, 1869.

Athletic Training and Health.

"HARK hither reader! wilt thou see
Nature her own Physician be?
Wilt thou see a man all his own wealth,
His own music, his own health;
A man whose sober soul can tell
How to wear her garments well;
A *well-clad soul*, that's not oppress'd
Nor choked with what she should be dress'd;
A soul sheathed in a crystal shrine,
Through which all her bright features shine;
A soul whose intellectual beams
No mists do mar—no lazy steams;—
A happy soul, that all the way
To heaven hath a summer's day?
Would'st see a man whose well-warmed blood
Bathes him in a genuine flood?
A man whose tuned humours be
A seat of rarest harmony?
Would'st see blithe looks, fresh cheeks, beguile
Age? Would'st see December smile?
Would'st see nests of roses grow
In bed of reverend snow?
In sum, would'st see a man that can
Live to be old and still a man?
Whose latest and most leaden hours,
Fall with soft wings, stuck with soft flowers;
And when life's sweet fable ends
Soul and body part like friends;
No quarrels, murmurs, no delay;
A kiss, a sigh, and so away—
This rare one, reader, would'st thou see?
Hark hither reader, and *thyself be he.*"

THE word 'health' is Saxon, but in the mouths of our ancestors *haeleth* signified not a healthy man only, but a hale man, a brave man, a hero.

A definition of health must include the mind as well as the body; indeed, it has been asserted that the search after health is the search after happiness, and a perfect knowledge of the whole subject may almost be said to constitute philosophy or the search after wisdom.

Great authorities hold that moral obliquity is a condition of mental, or brain disease, and it is unquestionable that madness often takes the form of homicidal mania, which is an irresistible temptation to transgress the sixth commandment; or of cleptomania, an uncontrollable desire to break the eighth; or of dipsomania, which is an ungovernable tendency to get drunk.

There are mild or obscure forms of these and similar diseases, and persons afflicted with such ailments may be seen at Millbank or Pentonville, undergoing a treatment there which is seldom curative, though it may often be deterrent.

"A costive habit," says Kotzebue, "may extinguish the divine flame of genius."

Though we may doubt the intimate connection between the mental, moral, and physical parts of man which these opinions seem to imply, none will, at any rate, deny that few possessions are so valuable as mere bodily health: the want of it greatly limits our capacity for usefulness, and lessens the enjoyment of every pleasure, sometimes even rendering life a burden too heavy for us. Yet how seldom do we seriously reflect on the means of acquiring or retaining this great treasure, and how few act up to their convictions when, at last, they have been induced to think on the subject: "For it is not easy," said Cullen, the celebrated physician, "to engage men to break in upon established habits, or to renounce the pursuits of pleasure; and particularly to persuade men *that those practices are truly hurtful which they have often practised with seeming impunity.*" "Nature commonly allows us to go on violating her laws for years without any apparent retribution; she runs long accounts with her children, and, like a cheating attorney, seldom renders her bill until the whole subject of litigation is eaten up[a]."

Some of my readers will, perhaps, think that there is no very direct relation between the general subject of health and the rules of athletic training; and not a few recent writers of eminence have attempted to shew that increase of muscular strength in any great degree, by gymnastic exercises and athletic training, is absolutely prejudicial to health. Among these last is a contributor to one of our most popular magazines, who makes the following objection to physical training. "The muscular system," he asserts, "is forced into undue development, and this development has been at the expense of the general vitality;" and "the amount of general vitality which should be distributed among several organs has been so unequally apportioned, that some of them are starved" to over-feed the muscles. Now this writer assumes, in opposition to the teaching of science, that the muscular system can be developed by regular and continued exercise without a corresponding development of the other systems and organs. Physiology justifies an entirely different conclusion; we cannot increase our muscular power without, at the same time, proportionately invigorating the whole body. To carry out our resolutions an act of will is required; the command issued by the will is conveyed from the brain, through the nerves, to the muscles: the nerves stimulate the muscles to contract, *and the strength of this contraction is probably due as much to the force of the nervous stimulus,* as to the contractile power of the muscular system. Then, too, the heart and blood-vessels, in obedience to the physiological law of hypertrophy, increase in weight and power to meet the demand of the hungry muscles for blood, which, like Jack-the-Giant-killer's foe, is the food they crave. The blood-vessels are strengthened to convey, and the lungs to aërate, the fuller vital stream; the stomach, by increased appetite, proclaims itself able and anxious to prepare the large supplies of *chyme* required to replenish the blood, while the muscles still grow stronger in answer to the call for greater force, and it is thus that the whole frame is exercised and strengthened. The invariable sequence, or law, of hypertrophy, to which allusion has just been made, is somewhat similar to the political economist's "law of supply and demand." It may be stated thus:—

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[a] "Information for the People."—*Chambers.*

Increase of function in an organ leads to augmentation of power.

The conditions that give rise to hypertrophy are three, viz.—

1. The increased exercise of a part in its healthy function.

2. An increased accumulation in the blood of the

particular materials which a part appropriates in its nutrition or in secretion.

3. An increased afflux of healthy blood[b].

If, for example, one kidney or lung be destroyed or disabled, it is in obedience to this developmental law that its fellow acquires greater size and activity to meet the demand for double work now made upon it; and, acting in accordance with this knowledge, the whole body, not excluding the bones, may be increased in vital power and strength long after the period of growth has been passed.

The magazine writer, whose main objection has just been stated, quotes the strictures of the "Lancet" on the condition of Heenan at the time of his fight with King; but the reasoning of the "Lancet" was only applicable to over-training. No one will deny that it is possible, by excessive labour, to produce a state of ill-health.

There is, of course, a limit to physical development; when this limit is reached the destructive assimilation begins to exceed the constructive, and then the vigour of the body rapidly decreases; but while the strength continues to improve, it is certain that this limit has not been reached. Intellectual exertion, if too constant and powerful, produces similar ill-effects. Every good thing may be carried to excess; but in the direction of athletic exercise this error is rare, considering it only from the physician's point of view.

Heenan, before his great fight with Sayers, had been undergoing the strictest training for five or six months, and yet "after fighting for two hours, he was so fresh as to leap over several flights of hurdles, and distance many of his competitors in the race." Did this shew "depression of power?" Sayers, too, a man who had gone through many years of training, during a long pugilistic career, living a life of anything but soberness or chastity, and who was thirty-eight years old, received on that occasion probably the severest pummelling ever administered in the ring, a pummelling which included twenty knock-down blows, yet the very next day he was seen walking vigorously through the streets of London, evidently in robust health and in excellent spirits. This certainly could not indicate "exhausted *vital* energy."

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[b] Paget.

Since that time it appears that the life of one, if not both, of these men has been a round of reckless debauchery, and this course of living has at last taken fatal effect upon Sayers.

It has been said that no man can be kept in a state of the highest muscular development for any length of time without serious detriment to his health. Now there is ample reason to believe that this state, in which a man cannot be kept without injury, *is not the height of condition*, but is rather some result of an erroneous combination of dieting and exercise, by which the waste has been made to exceed the supply. In a northern village well known to the writer, pedestrianism has, during the last year or two, been very much in vogue among the labourers and farmers' sons, and they, acting upon the advice of an old professional pedestrian who cultivates his laurels there, live almost entirely upon *hard boiled eggs and vinegar* for some weeks before their autumnal foot-races come off!

A state of perfect physical training, or that condition in which a man is able to make the most vigorous exertion of which his body is capable, is also the highest condition of health.

Another objection made to strong, regular, and frequent exercise is contained in the assertion that the processes of assimilation and disintegration go on too rapidly, and that the man who is working hard at gymnastic exercises lives much *faster* than is consistent with longevity, the vital force allotted to him being rapidly expended, and thus an active athletic life ensures an early grave. The comparatively short lives of prize-fighters are adduced as examples of this effect, and melancholy stories are told about whole crews of University oarsmen being cut off in the prime of their youth and vigour, as a consequence of their aquatic exploits.

This last objection, if valid, applies to every degree of muscular or mental exertion, and to work of *every* kind, as all labour is accomplished by the disintegration of pre-existing tissues. If there was any truth in this theory, a life of absolute mental and physical inaction would be most conducive to longevity and happiness, whereas abundant experience testifies that the reverse of this is true.

If we are not intended for a life of active exertion, the Creator must have placed the savage races in a condition for which they are not fitted, and this is contrary to the analogy of His dealing with all other animals.

"The law by which all else are bound
Binds man the lord of all. Himself derives
No mean advantage from a kindred cause,
From strenuous toil his hours of sweetest ease.
The sedentary stretch their lazy length
When custom bids, but no refreshment find,
For none they need; the languid eye, the cheek
Deserted of its bloom, the flaccid, shrunk
And wither'd muscle, and the vapid soul
Reproach their owner with that love of rest
To which he forfeits even the rest he loves.
Not such the alert and active. Measure life
By its true worth, the comfort it affords,
And theirs alone seems worthy of the name,
Good health, and its associate in the most,
Good temper; spirits prompt to undertake
And not too soon spent, though in an arduous task.
The powers of fancy and strong thought are theirs;
Even age itself seems privileged in them
With clear complexion from its own defects.
A sparkling eye beneath the wrinkled front
The vet'ran shews, and, gracing a grey beard
With youthful smiles, descends towards the grave
Sprightly and old almost without decay[e]."

The natural state of man is one in which prolonged and severe exercise is frequently taken, and our instinct would still lead us to do this, but artificial modes of life have caused many to acquire sedentary habits, which hide or overcome the instinctive promptings of their nature. Yet the abundance of food which, through civilization, we so easily obtain, renders exercise much more necessary for our physical being than it is for the athletic Red Indian or the stalwart Maori of New Zealand.

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[e] Cowper.

The jerking motions of an infant, apparently so meaningless, are really gymnastic exercises, the earliest lesson of physical education dictated by nature; and these movements, if vigorous, should be looked upon as indications of a strong vitality.

It is easy to account for the early death of professional pugilists, when we recollect that their lives, with very few exceptions, are made up of alternate periods of reckless debauchery and of strict training, varied again, in not a few cases, by weeks and months of the severest privation and want. It is most probable that the lives of these men would be of even shorter duration if they did not train at all, notwithstanding the faultiness of their training systems. All successful pugilists become publicans, this is their highest aspiration, and Dr. Farre's tables prove the death-rate of inn and public-house keepers to exceed that of any other class. Those prize-fighters who have not been fortunate enough to establish a hostelry of their own are always to be found lounging about the houses of their more puissant brethren, where they earn a precarious living by teaching, or exhibiting, their skill "in the noble art of self-defence." The crack watermen are a less dissolute class, and therefore retain their health and vigour much longer, though they train as strictly.

Teachers of gymnastics and of fencing undergo a great and constant amount of muscular exertion in order to acquire, retain, and impart their skill in athletic exercises. In respect of morality their lives resemble those of the most respectable middle-class citizens. You shall hear if they are men who die prematurely, and no statements shall be made which do not relate to men well known in their calling.

"The founder of Angelo's School of Arms died in 1802, in the eighty-seventh year of his age. He retained his bodily and mental powers so fully to the last, that he continued to give lessons in fencing till a few days before his death. His son and grandson successively almost equalled him in length of days. Another proof that the master of the sword can defend himself against the scythe of time is furnished by M. Leon Gillemand, who has been long known as one of the most accomplished *maîtres d'armes* in London, and who served in the French army at the battle of Waterloo. It may be inferred from this fact that M. Gillemand is older than the present century, but those persons who saw him for the first time at Willis's Rooms last week (May, 1868) would infer that he was a dozen years younger[d]."

Capt. Chiosso (of Oxford-street) some years before he died claimed to be one hundred years old, and though his appearance was exceedingly venerable, his upright carriage, quickness of eye, hand, and ear, led many to doubt his centenarian pretensions. He gave the present writer some fencing lessons a year or two before his death.

The annually revived and heart-rending University boat-race story, which has so often horrified the con-

[d] Article *Fencing*, "Saturday Review," May 16, 1868.

fiding public, should, like the burning effigy of Guy Fawkes, be looked upon as a grim periodic joke; but unlike the gunpowder-treason-and-plot anecdote, this boat-race fiction does not seem ever to have had any foundation in fact. I refer to the tale which is everywhere current soon after the University boat-race, each year—how that the victory of Oxford or Cambridge was purchased at a very high price, for, alas, those splendid young fellows, Brown, Jones, and Robinson, who pulled 'six,' 'seven,' and 'stroke,' in the winning boat, are now lying "six feet deep in churchyard mould."

Mr. P. P. Pennant, in a letter to "The Times," (dated Oct. 26, 1867,) writes as follows:—

"From 1854 to 1859 I was at Cambridge, and from rowing at Putney and Henley, and being connected with University boating during that time, I had the opportunity of becoming acquainted, more or less, with most of the oarsmen who represented the University during those years. I find that they number in all sixty-eight, some of whom rowed on more than one occasion. Of these sixty-eight I have entirely lost sight of forty-one; of the remaining twenty-seven, who have not vanished from my horizon, I do not know a single one of whom it has been even suggested that his health has been at all injured by rowing."

"A Sexagenarian" gives confirmatory evidence in another communication to "The Times," (Oct. 22, 1867):—

"Forty years ago I steered one of the Cambridge racing boats for a year and a half. During that time there were fourteen of my fellow-undergraduates who formed part of the crew, of ages varying from eighteen to twenty-one. Of these two are now dead, one having died after a long illness, which I hardly think Mr. Skey would have attributed to hard rowing; the other of an epidemic fever. A third was alive and hearty a few years ago, and I have no reason to believe he has died since I last heard of him. The remaining eleven are now alive; several of them in positions of great dignity. Surely, even if the doubtful life be added to the deaths, the number still alive is not below what the tables of healthy lives would assign as the proportion who ought now to be alive."

The following conversation on this subject is related in "Sketches from Cambridge, by a Don:"—

"'Why, my good fellow, rowing is a fine, healthy exercise.'

"'Healthy exercise!' he replied, "did it not kill seven of the University crew of 1851 in four years?'

"Now in 1851 there was no University crew; and moreover the story has been told to my knowledge of every crew for the last twenty years. By way of soothing him I reply, 'Yes, I know that to be true, for no less than five of the crew have severally assured me that each of them was the only survivor; as for you, however, you are as sound as a bell.'

"This last unpardonable insult naturally arouses his anger; he overwhelms me with stories of A, B and C, whose deaths were clearly traceable to their exertions in boat-races. It is in vain that I reply that boating is no certain antidote to existing consumption, nor to over-indulgence in whiskey or mathematics; and that most of these cases are attributable to these causes."

Sir Francis Head, in "Rough Notes of Journies across the Pampas," writes as follows:—

"When I first crossed the Pampas I went with a carriage, and although I had been accustomed to riding all my life, I could not ride at all with the peons, and after gallopping four or five hours was obliged to get into the carriage; *but after I had been riding four or five months, and had lived on beef and water, I found myself in a condition which I can only describe by saying that I felt no exertion could kill me.*"

Sir Francis had undergone a severe course of training, by which his "general vitality" does not seem to have been very much "depressed," and he evidently did not think himself "less able to withstand the wear and tear of life than the feeble student."

Nor does the "Lancet" endorse the statement that athletes are less able to withstand the attacks of disease and the wear and tear of life than the feeble student, as the following extract from its columns will shew:—

"The hours spent in sitting on the benches 'of the lecture-rooms' will be likely to be more profitable to the mind *in the proportion that the body is brought nearer to the perfection of health and strength.* The student must bend for long hours over his books, and must consume the midnight oil (or gas). If he find relaxation from these depressing labours in dissipation, he will but sharpen the edge of the physical danger to which his studies expose him. We earnestly counsel the avoidance of all forms of dissipation, and a resort to healthy active exertion in the open air, and should be glad to hear that every school had its club and that every student took his share in these physical sports. The physiological study of gymnastics has hardly occupied the attention of our profession so generally as it might have done, and a good deal of harm occurs from the prevalence of erroneous opinions as to the value of particular forms of exercise and the impunity with which they may be cultivated[*]."

The development of muscle on a man is in no way comparable with the fattening of a pig, as has been asserted. In the process of fattening, motion is restricted, and the vital action of all the organs is lowered, except those concerned in digestion, while a vegetative kind of life is encouraged, that fat may accumulate, which is a substance of the lowest, while muscle is of the highest organization. When thus formed it impedes the functions of the various organs, and their proper muscular or other tissues sometimes become gradually superseded, or degenerated, into this substance of low vitality, until, at last, death ensues. It is in this way that old people often die slowly.

Physical training, judiciously applied, is not only the best means of preserving health, but it is also a most valuable auxiliary to medicine in the treatment of positive disease, though too seldom employed by modern physicians.

The occasional success which attends the practice of Homœopaths, Hydropaths, &c., is to be accounted for by the prominence which they give to diet and exercise in their treatment of disease, and thus the patient gets well in spite of the wet sheets on the one hand and the globules on the other.

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[*] Athletes at School, "Lancet," Oct. 28, 1865. The writer of this Essay founded the first of these Athletic Clubs when a Student of King's College, 1858.

"There is a story in the Arabian Nights' Tales, of a king who had long languished under an ill habit of body, and who had taken abundance of remedies to no purpose. At length, says the fable, a physician cured him by the following method: he took a hollow ball of wood, and filled it with several drugs; after which he closed it up so artificially that nothing appeared. He likewise took a mall, and, after having hollowed out the handle, and that part which strikes the ball, he enclosed in them several drugs, after the same manner as in the ball. He then ordered the Sultan, who was his patient, to exercise himself early in the morning with these rightly-prepared instruments until such time as he should sweat; when, as the story goes, the virtue of the medicaments perspiring through the wood had so good an influence on the Sultan's constitution that they cured him of an indisposition which all the compositions he had taken inwardly had not been able to remove. This Eastern allegory is finely contrived to shew us how beneficial bodily labour is to health, and that exercise is the most effectual physic[f]."

The physicians of ancient Greece and Rome were also much indebted to remedies of this kind, indeed gymnastic exercises occupied the place of honour in their pharmacopœia. Ikkus of Tarentum and Herodicus are mentioned by Plato[g] as the introducers of gymnastic medicine.

Asclepiades, a physician, who acquired great reputation at Rome (B. C. 90), almost discontinued the use of internal remedies in his practice, and pointed to his own healthy state as an example of the soundness of his method; it is also related of him, that when a young man he agreed to forfeit all claim to be called a physician if he was ever ill, or died but from old age, and strange to say, he lived to be more than one hundred years old, and even then was only killed by a fall. Celsus mentions Asclepiades and his method of cure, but none of his writings have been preserved. Lucian, who wrote at a later period, probably about the time of the Emperor Commodus, says of these exercises that they "perform the same office to the human frame that winnowing does to corn; the chaff and impurities are blown away and the pure grain only is left behind[h]." Galen and Hippocrates were both enthusiastic in their praise of gymnastic exercise. The former lived to be ninety years old and the latter died at the age of ninety-nine, free from either mental or physical infirmity.

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[f] "Spectator."

[g] *De Republica*, lib. iii.

A well-known authoress relates the following instance of benefits derived from what was really a system of training, in the case of hereditary predisposition to consumption:—

"A family of five brothers and sisters were left, by the death of their widowed mother, to choose their way of life for themselves, at ages varying from sixteen to twenty-two. They made a wise choice, which was acquiesced in by the guardians of the younger ones. They had no *marked* disease, any of them, but that they were of a strumous constitution their physicians admitted. They resolved to devote five years to the establishment of their health, which they considered would be a wise economy of time, if those years would give vigour to all that followed. There was no difficulty about money, so they took an airy country-house on a gravelly soil, bought horses for five, hired two grooms, and devised a side-saddle for the girls which would enable the rider to take either side of the horse at pleasure —a point of some importance to growing girls who were to spend so much of their time on horseback. They were in the open air whenever the weather would possibly admit of it, *varying their exercises in every imaginable* way. They lived on generous diet, beef and mutton in plenty, and, by the medical advice of the day, port wine. At the end of five years they were as fine a set of young people as could be seen, without a trace of disease or weakness, sound in mind and body."

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[h] Anacharsis, sect. 25.

The general adoption of such habits of exercise and regimen as physiology and chemistry of food declare to be the best for us, or in other words, a systematic physical education based upon science and experience, would probably extirpate that long list of diseases which arise from disorder of the nutritive processes of the body, and which, as Professor Hughes Bennett affirms, may all be traced to the following causes:—

1 An improper quantity or quality of food.

2. Circumstances preventing assimilation or impeding respiration.

3. Altered quantity or quality of the nutritive matters passing out of the blood.

4. Accumulation of effete matters in the blood.

5. Obstacles to the excretion of these from the body.

Nor is it the physical energy alone that is in this way increased. The utmost vigour of mind is not possessed by any individual unless the body is in a state of perfect health. The brain and nervous system are parts of the body through which the mind is manifested, and unless the rest of the organism is in a state of health the brain cannot be properly nourished, and its functions will, in consequence, be imperfectly performed. The cerebral substance, like all other portions of the frame, derives its nutriment from the blood, and if active exercise be neglected, this fluid, imperfectly oxygenated, and loaded with impurities from the languid action of the liver, skin, and other excreting organs, circulates in the brain, and the necessary consequence is, decreased intellectual and constitutional vigour. The services which the brain performs for the mind *must be* most perfectly rendered when that organ, together with the whole frame, is in the highest state of health. This view is quite distinct from the materialistic theory, which regards the soul merely as a function of the body.

It is a common but very great error to believe that high intellectual powers are generally associated with puny frames and slight muscular strength. Balliol, though not one of the largest of Oxford's colleges, is seldom far from first in the Schools and on the river. Many of our cleverest lawyers, divines, and physicians have been noted oarsmen.

Dr. Robert Hussey, late Regius Professor of Ecclesiastical History at Oxford, is stated to have been "studious as a boy, though no bookworm, leading at the same time a healthy out-door life. On leaving Rochester School for Westminster, as seventh King's Scholar, he was tall and athletic enough to be at once taken into the college boat. At Oxford he rowed in the Christ Church eight and he came out a double first." Mr. Anthony Trollope is known to be one of the first flight in the hunting-field as well as in fiction. Mr. Thomas Hughes is said to be an accomplished boxer; and Christopher North was a favourite instance of the union, in one person, of extraordinary muscular strength and high intellectual powers. Many other examples might be found among the leading men in art and in literature, in law, physic, and divinity.

Though men of intellect may keep their muscles in the background it by no means follows that they are ill-provided with, or habitually neglect, them. The foremost man of his time, Leonardo da Vinci, possessed beauty and strength in no common degree. He could bend an iron horse-shoe and roll up a brass rod into a screw. One of the four greatest painters, he was also an architect, sculptor, mathematician, engineer, anatomist, poet and musician, "in short, he left untouched very few of those objects which have engaged the attention of the human faculties[1]."

Addison, after pointing out the necessity of exercise, thus describes his own habit:—

> "For my own part, when I am in towns, for want of these opportunities I exercise myself an hour every morn-

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[1] Roscoe's "Life of Leo the Tenth."

ing upon a dumb bell that is placed in a corner of my room. When I was some years younger than I am at present, I used to employ myself in a more laborious diversion, which I learned from a Latin treatise, and which consisted in the brandishing of two short sticks grasped in each hand and loaden with plugs of lead at either end. This opens the chest, exercises the limbs, and gives a man all the pleasure of boxing without the blows[k]."

Boerhaave was a man whose "reputation was almost without a precedent, and which scarcely knew any other limits than those of the civilized world. There is a story that a Chinese mandarin wrote him a letter, which easily reached him, addressed merely—*To Boerhaave in Europe*[l]." He was perhaps the first in rank among physicians. Hutchinson says that,—

"He was of a robust and athletic constitution of body, so hardened by early severities and wholesome fatigue, that he was insensible of any sharpness of air or inclemency of weather. He was tall, and remarkable for extraordinary strength. There was in his air and motion something rough and artless, but so majestic and great at the same time, that no man ever looked upon him without veneration, and a kind of tacit submission to the superiority of his genius. He was always cheerful and desirous of promoting mirth by a facetious and humorous conversation. He was never soured by calumny and detraction, nor ever thought it necessary to refute them, 'for they are sparks,' said he, 'which, if you do not blow them, will go out of themselves.' His good temper, dignity, forbearance, and sympathy are qualities oftenest found among those who have not been soured and rendered querulous by protracted ill-health, but whose hardy frames enable them to bear with placid stoicism the anger of men, the fury of the elements, or 'the slings and arrows of outrageous fortune.'"

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[k] "Spectator."

[l] "National Encyclopedia."

"There is a connection, an actual literal connection, between the blue sky and cheerfulness of heart, between crimson clouds and generous feelings, between dewy flowers and gracious kindness, between exercise of limb and lung on green or heathy knolls and manly frankness and courage, and between the absence of all these and sunken degradation of soul[m]."

Experience and science unite in teaching the necessity of coupling mental and physical education. The soul and the bodily part of a human being are far too intimately united in all their workings to allow of the one being disregarded in dealing with the other.

> "... Think it no more.
> Nature, crescent, does not grow alone
> In thews and bulk, but as this temple waxes,
> The inward service of the mind and soul
> Grows wide withal."

Not only is it true that the necessity of a complete physical training remains unrecognised by the majority of people, it is equally true that some have attained to eminence by successful brain-work, though they have systematically violated the most obvious and well-known rules of healthy living. Eichhorn, who, it is said, never left his house for twenty-five years, wearing neither coat nor shoes during all this time, and Cornaro, who only allowed himself the smallest quantity of food consistent with the maintenance of life, were men who seem to have kept their brains in good working order, though they quite neglected the development of their biceps. Others, whose dinner, when luxuriously inclined, consisted of a cabbage and a glass of water, have managed to exist on no better fare for a long course of years. One, Roger Crab, determined to follow literally the injunctions given to the young man in the Gospel; he sold his property, distributed the proceeds among the poor, and then having imbibed the idea that it was sinful to eat any kind of animal food, or drink anything stronger than water, he lived in a small hut near Ickenham, upon a sum of three-farthings a-week; his food consisted of bran, dock-leaves, mallows, and grass[n].

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[m] "St. Paul's Magazine," Article *Progress*, 1868.

If some who live like these come to be great men, how much greater, in more senses than one, might they not become, if they adopted a mode of living more consistent with the teaching of science?

Old Parr is said to have reached an extraordinary age, and, if we are to believe certain advertisements, pills formed the staple article of his diet; he must have eaten them like peas, with a fork. Even if we try to rival his reputed powers of deglutition and swallow the story of his passion for pills and of his surprising longevity, does it follow that we should live as long by adopting his tempting fare? On the contrary, it seems more probable that Old Parr would have run a close race with Methuselah himself, if he had taken a three mile "spin"

[n] "The Book of Days."

before dinner and let his bowels have peace. So of Eichhorn, Cornaro, and the rest.

Men who have achieved fame by great thoughts and actions have generally lived to a great age, and thus we are taught, by the pages of history, the intimate connection between health of mind and of body, between greatness and strength. But it is hardly necessary to search the records of the past for confirmation of this deduction; the most eminent lawyers, statesmen, and soldiers of the present century will serve as examples of it.

"It is beyond all doubt, that decision of character very much depends on the constitution of the body. It would be for physiologists to explain, if it were explicable, the manner in which corporeal organization affects the mind. I only assume it as a fact, that there is in the natural constitution of some persons, much more than of others, some quality which augments, if it does not create, both the stability of their intention and the energy of their active tendencies. There is something that braces round (if I may so describe it) and compresses the powers of the mind, giving them a steady forcible spring and reaction which they would presently lose if they could be transformed into a constitution of soft yielding treacherous debility. The action of strong character seems to demand something firm in its material basis, as massive engines require, for their weight and for their working, to be fixed on a solid foundation. Accordingly I believe it would be found, that the majority of persons most remarkable for decisive character, have possessed great constitutional physical firmness. I do not mean an exemption from disease and pain, nor any certain measure of mechanical strength, but a tone of vigour the opposite to lassitude, and adapted to great exertion and endurance. This is clearly evinced in respect to many of them, by the prodigious labours and deprivations which they have borne in prosecuting their designs. The physical nature has seemed the proud ally of the moral one, and with a hardness that can never shrink, has sustained the energy that could never remit. A view of the disparities between different races of animals, inferior to man, will shew the effect of organization on disposition. Compare, for instance, a lion with the common beasts of our fields, many of them larger in bulk of animated substance. What a vast superiority of courage and impetuous and determined action! Which difference we attribute to some great dissimilarity of modification in the composition of the animated material. Now, it is probable that a difference, somewhat analogous, subsists between some human beings and others, in point of what we may call mere physical constitution, and that this is no small part of the cause of the striking irregularities in respect to decisive character. A man who excels in the power of decision has, probably, more of the physical quality of the lion in his composition than other men. It is observable that women have less inflexibility of character than men; and though many moral influences contribute to this difference, the principal cause may probably be something less firm in the corporeal constitution [*]."

In a late controversy on the question before us much stress was laid on "the difference between muscular and constitutional vigour, and still more on the difference between animal vigour, whether muscular or constitutional, and what physiologists call vital force[p]." Now these terms "constitutional" and "vital" are merely convenient phrases behind which to hide our ignorance. The difference between animal vigour and "vital force" represented as being fraught with so much importance is simply *nil*. The forces in living beings which have not yet been accounted for by the laws of physics are called *vital*. The number of these unknown or *vital* forces is rapidly diminishing with the progress of science, but scarcely any functions can, at present, be *wholly* explained by physics, and muscular contractility and nervous sensibility are still as vital as any of them.

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[*] Essay on "Decision of Character."

By "constitutional vigour" is meant that power of constantly recovering from illness, and of enduring physical suffering and hardship, which is often possessed in an eminent degree by persons who are far from muscularly strong. Such persons, it is said, must have a strong something somewhere, What is that something? When this question is asked a refuge is generally sought behind the words "vital" and "constitutional," e. g. "The general vitality has been great," &c. But if each case of the kind be carefully observed, it will be found that "constitutional vigour" resolves itself into either a strong stomach, or heart, or lungs, or a hopeful disposition, or all of these, giving the patient "vitality" to make a good fight against the tubercle in his lungs, or the cancer in his liver, or the fever which has taken possession of his whole system. Now systematic training, when judiciously applied, increases the power of all these internal organs; this, indeed, is the main object which an athlete should have in view, for it is only by their aid that he can attain the power of prolonged and great exertion.

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[p] "The Times," Oct. 1867.

The very *raison d'être* of these internal organs is that we may have muscles for action and brain for thought.

There have been, as the poet suggests, many simple peasants whose hands

> "The rod of empire might have swayed
> Or waked to ecstasy the living lyre.
> But knowledge to their eyes her ample page
> Rich with the spoils of time did ne'er unrol."

If these "rude forefathers of the hamlet" had developed, by mental training and favourable circumstances, into glorious Miltons or patriotic Hampdens, their "vital force" would have been strengthened, *cæteris paribus,* rather than weakened, in consequence; and it is even more certain that the pale student has no greater, but a less amount, of "constitutional vigour" to resist disease and the tendency to death, while his muscular energies remain uncultivated.

Each individual has powers of mind and of body which are capable of being developed greatly, but there are limits, and it is not in the effort to reach, but to pass, these limits, that injury occurs.

The result of fully exercising all the organs in the performance of their healthy functions would be perfect and complete internal and external symmetry. Bechard's definition of life is "organization in action," and the regular well-balanced action of all parts of an organized being is health.

"The heavens themselves run continually round; the sun riseth and setteth; the moon increaseth and decreaseth; stars and planets keep their constant motions; the air is still tossed by the winds; the waters ebb and flow, to their conservation, no doubt to teach us that we should ever be in action[q]."

Plato, in Pythagoras, calls him a cripple, who, cultivating his mind alone, suffers his body to languish through sloth and inactivity; and in his ideal republic he prescribes for the higher citizens an education in which literature and gymnastic receive an equal share of attention; and it is an error, he says, "to conclude that the one is for the soul alone, and the other for the body alone, but both are prescribed mainly for the sake of the soul[r]." It was clearly the opinion of Plato, that "the great object of all education was to temper and blend these two elements together in just and harmonious proportion[s]."

Plato himself was carefully instructed in the learning of those days, and in gymnastic, by the most eminent masters of the time. He lived to be eighty, or eighty-three, his health was robust, and he received the name of Plato from the breadth of his shoulders, having previously borne the name of Aristocles.

Indeed, all the most illustrious Greek and Roman citizens, those who were distinguished in art and literature as well as their great warriors, passed through a complete course of physical education; and the still unrivalled sages and philosophers who flourished in those early days agreed with Plato in considering a state to be badly constituted if, like our own, it did not encourage and provide the means necessary for bodily training. Nor will it be difficult to obtain evidence in favour of such an education from the works of modern writers, whose opinions, on the subject of health, are entitled to much consideration. Here and there, in books not addressed to the general public, and which only treat of this matter incidentally, passages will be found like those which follow:—

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[q] Burton's "Anatomy of Melancholy." [r] "Republic" of Plato, book iii. [s] "Analysis of Republic," by Davies and Vaughan.

"In the higher classes of society it is too frequently the case that the solicitude of parents as to the mental culture of their children interferes materially with the maintenance of physical health; and this is the chief reason why, in schools especially, there is too little time devoted to vigorous exercise and too much to sedentary intellectual work. A due provision in female educational establishments for taking *strong vigorous exercise* is still a desideratum[t]."

"I have the strongest reason for believing that in the upper classes of society those formidable complaints which are supposed to arise from a scrofulous state of the constitution, are, in the great majority of instances, induced by the folly of attending exclusively, in the education of youth, to the improvement of the mental at the expense of the muscular powers[u]."

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[t] "The Diseases of Women." Dr. Graily Hewitt.

[u] Carmichael.

> "If games were more patronized in youth, so many miserable, nervous, useless creatures would not abound. It would be well if Government would have such places of amusement in every large town, and if Government would not take it up, municipal corporations should, and what parent is there that would not lend a helping hand for their support when his children's health is at stake[x]?"

Below the ages of nine or ten the education of children should be almost entirely physical; and the common practice of keeping children of such tender years at book-work for more than half the day cannot fail to injure their constitutions, and weaken, rather than improve, their intellectual powers.

Mr. Chadwick has shewn that children learn much more quickly *when their school-hours are reduced to one-half their usual time, and a large proportion of play-time is allotted to them.* Let some portion of the holiday hours recommended by Mr. Chadwick be employed in regulated gymnastic exercises, and the gain to the country, as well as to the children themselves, would be beyond calculation.

> "They should never be confined to their studies for more than two hours at a time; a longer period can scarcely be attended with any advantage to their progress in knowledge, as their young minds are incapable of a more continued exertion; and if they are not allowed to indulge themselves frequently in recreation and play, they will only remain in mental as well as corporeal inaction[y]."

Exercise of the body should be made to serve as a relaxation for the mind, and *vice versa;* and this, as Rousseau declares, is the grand secret of education. Mere play, however, is not enough; we would never consent to leave the mental development of children to the chance reading of story-books. In every school play-ground there are youthful "solitaries" like Shelley, who mope in remote corners, and who, from morbid sensitiveness or physical weakness, decline to share in the rough games of their playfellows, games from which they, more than any others, might derive inestimable benefits.

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[x] Pye Chavasse.

[y] Carmichael on Scrofula.

"I have seen silly parents trying to get their children to say that they liked school-time better than play. I have seen with joy many little fellows repudiating the odious and unnatural sentiment, and declaring manfully that they preferred cricket to Ovid. And if any boy ever tells you that he would rather learn his lessons than go into the playground, beware of that boy—either his health is drooping and his mind becoming prematurely and unnaturally developed, or he is a little humbug—he is an impostor—he is seeking to obtain credit under false pretences. Depend upon it unless it really be, that he is a poor little spiritless man, deficient in nerve and muscle, and with an unhealthy, precocious intellect, he has in him the elements of a sneak, and he wants nothing but time to ripen him into a pickpocket, a swindler, or a horse-dealer[1]."

Those really noble institutions, the Public Schools and Universities of England, where so large a proportion of the gentlemen of this country receive their education, afford great facilities for the acquirement of bodily as well as mental vigour, and the students have only themselves to blame if they neglect the opportunities which are there offered to them, of arming at all points for the battle of life. There can be no doubt that a large section of university and public schoolmen have clear consciences in respect of one or the other branch of training; as a rule, it is far too easy to draw the line between reading and rowing men. But neither mathematics, nor whisky, nor athletics, should be condemned because they are occasionally indulged in to excess.

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[1] "Frazer's Magazine," Sept. 18, 1864.

"All things have a double power
Alike for good or evil. The same fire
That on the comfortable hearth at eve
Warm'd the good man, flames o'er the house at night;
Should we for this forego
The needful element?
Because the searching summer sun
Darts fever, would'st thou quench the orb of day?
Or deemest thou that Heaven in anger form'd
Iron to till the field, because when man
Had tipt his arrows for the chase, he rush'd
A murderer to the war?

* * *

O what a glorious animal were man,
Knew he but his own powers, and, knowing, gave them
Room for their growth and spread[a]!"

Good feeding, combined with a due exercise of the physical and intellectual powers, if persevered in for generations, strengthen and ennoble the human animal.

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[a] "Thalaba," Southey.

No country can produce a race equal to the thorough-bred gentlemen of these Islands; "and all agree," writes Hugh Miller (himself of peasant origin), "that nowhere else, in Europe, is the highest or Caucasian type of man to be found more true to its original contour than among the high-bred aristocracy of England." We might almost believe that the heralds were influenced by physiological considerations when they declared that the descendants of a gentleman by creation did not become gentlemen by blood, until the third generation. Race may have some influence in producing the superiority of size and form referred to by Hugh Miller, but it is no doubt due, in a greater degree, to the athletic training received during the period of growth at school and college, and to the taste for manly sports there acquired, together with the influence of an abundant supply of nutritious food, acting through several generations.

Thus some youths, following the promptings of nature, and availing themselves of unusual opportunities, manage to get a physical education, which, though far from complete, is still sufficient to produce a marked superiority over their fellows. Girls never have the chance, and seldom the wish, to do this. The monotonous daily walk of "the young ladies from Minerva House Seminary," painfully resembling, as Sir B. Brodie once remarked, a funeral procession, and the ridiculous sham called "calisthenics," which is sometimes practised there, are worthy of nothing but severest reprobation. Except the time devoted to what might be truly called "The Spectres' March," the entire day is spent within doors, and we have a right to expect that the result of a training so exclusively mental, obtained at so great a sacrifice of health, will justify the means, by producing women whose reasoning powers shall be strong though their constitutions may be weak. It cannot be denied that the fashionable girls'-schools most thoroughly deserve the title of Seminary[b], which they frequently assume; but the seeds which are sown broad-cast there are the seeds of disease rather than of learning. Finishing schools are also ominously named to indicate their action in maturing the fatal germs already planted by the earlier cultivators[c].

Ruskin, when describing the kind of education which would fit women for the very high and influential position that he is anxious they should occupy, spoke as follows:—

> "The first of our duties to her—no thoughtful person now doubts this,—is to secure for her such physical training and exercise, as may confirm her health and perfect her beauty; the highest refinement of that beauty being unattainable without splendour of activity and of delicate strength."
>
> "But from babyhood they (girls) are given to understand that helplessness is feminine and graceful; helpfulness—except in certain received forms of manifestation—unwomanly and ugly. The boys may do a thousand things that are *not proper* for little girls[d]."

Wordsworth must have been thinking of the stillprevailing prejudice in favour of muscular weakness and delicate health when he described Louisa as possessing so much unlady-like and "vulgar" vigour:—

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[b] From *seminarium*, 'a seed-plot.'

[c] Vide page 38.

[d] "A Woman's Thoughts about Women."

"I met Louisa in the shade,
And having seen that lovely maid,
Why should I fear to say,
That she is *ruddy, fleet, and strong,*
And *down the rocks can leap along,*
Like rivulets in May."

If only for the sake of posterity, the physical healthfulness of women should be secured at any cost. The hygienic condition of one generation is bequeathed to the next with infallible certainty. It can be shewn that almost all diseases have a greater or less tendency to become hereditary. In thinking of hereditariness, remember that we resemble, in our strength or weakness, and in all other characteristics, (including mental ones,) all our ancestors, though we generally retain more of the qualities that distinguished our immediate predecessors.

Although health and beauty may be found dissociated, their constant tendency is to unite. Vigorous exercise begets health and strength, these beget symmetry, and symmetry is beauty of form. In the same way moral health and intellectual strength give beauty of feature, and all these qualities are inter-dependent.

No nation, except the Greeks, has ever regarded the education of the mind and the body as of equal importance; they were at one time the wisest, the most beautiful, and the most athletic of ancient nations; it may be doubted if any other country has, even yet, produced heroes, philosophers, human forms, or sculptors equal to those of ancient Greece, notwithstanding the advantages which we of the modern world enjoy from ages of civilization. Their most heroic achievements, their highest mental and bodily cultivation, their most perfect social organization, and the greatest development of their art, was contemporaneous.

There can be but little doubt that their pre-eminence in sculpture was directly due to the perfect models which physical education provided for them.

"The custom of erecting statues to victorious athletes, which was established from the fiftieth to the sixtieth Olympiad, was strongly in favour of the improvement of art, and its complete emancipation from certain consecrated usages, which had previously hindered its free development. *It was real portraits*, not mere hieratic models or conventional types, that were required of these victorious athletes, in whom nature and training had combined every physical advantage, and who were the pride of their native towns and of all Greece."

We have no such models—we have not the conditions required for their production, hence Phidias and Praxiteles remain unrivalled.

A book was written some centuries since by a French physician which was called "Abdeker, or the Art of Cosmetics"; the painted dames of that period eagerly read the volume, and found that the great secret revealed therein was the beautifying effect of temperance and exercise. Dr. J. Johnson gives similar counsel to the belles of our day:—

"I would recommend," he says, "some of my fair countrywomen, who have leisure as well as means, to improve the languid state of their circulation and the delicacy of their complexion by a system of exercise which will give colour to their cheeks, firmness to their muscles, tone to their nerves, and energy to their minds."[*]

English women rarely get more exercise than a quiet walk affords, and, as this alone is quite insufficient to expand the chest, or thoroughly exercise the lungs, small, ill-formed chests are the rule, and the various pulmonary affections, among which consumption is the chief, are the most fatal diseases of this country. Now, although it would not be correct to place these two facts always in the relation of cause and effect, there is no doubt that they are very frequently thus related; and it is certain that tubercular disease would very much decrease, if only some pains were taken to exercise the lungs and provide for their free action by strengthening the muscles of respiration, and expanding the chamber in which they work. With this sin of omission, another of commission is often combined in the case of women. The report of the Registrar General of Births, Deaths, and Marriages contains this passage:—

"The high mortality of English women by consumption may be ascribed partly to the indoor life which they lead, and partly to compression preventing the expansion of the chest, by costume. In both ways they are deprived of free draughts of vital air, and the altered blood deposits tuberculous matter with fatal and unnatural facility—

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[*] "Morbid Sensibility of the Stomach." Dr. G. Johnson.

31,090 English women died in one year (ending June 30, 1839) of this incurable malady."

Few medical men will dissent from this opinion, which is more than confirmed by Dr. John Brown[f], who says, "it is certain that more than half of these deaths could be prevented if the lungs had fair play."

The most able of recent works on consumption, a prize essay by Dr. Perrond, of Paris, strongly enforces a similar view.

When ladies come to see that the great and only true beautifier is vigorous health-giving exercise, the fatal and most absurdly disfiguring custom of wearing stays will be abandoned; and then, instead of contracting their figures into a shape very nearly resembling that of a penny doll, which seems to be the fashionable ideal of a good figure, nature will be allowed to do her best, insect-like waists and red noses will no longer offend our eyes, and offensive breath our olfactory nerves, scrofula and consumption will cease to plague us, and forms surpassing

"All the nonsense of their stone ideal,"

will *then* be far from rare.

But if, instead of gazing into the future with optimist eyes, we survey the figure of any contemporary beauty, the following lines from Moore will better express what we shall see:—

"Lesbia wears a robe of gold,
But all so tight the nymph hath laced it,
Not a charm of nature's mould
Presumes to stay where nature placed it."

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[f] "Plain Words on Health."

And when, at no distant period, poor Lesbia dies, for the only advantage of this custom is, that it helps to kill off quickly the most foolish women, it will be found that the external distortion is slight when compared to the deformity within. It is easy, says the anatomist, to distinguish the effects of tight lacing, even after death. The lower ribs are permanently depressed to a greater or less extent, and, at the spot where "the waist" has been established, they are quite altered in form. A corresponding depression is made on the surface of the liver, which is lengthened, narrowed, and forced upwards, where it encroaches upon the space allotted to the lungs. Lateral curvature of the spine is mainly due to the bad influence of stays.

"By the use of the corset the action of the back muscles is restrained and in some degree superseded. Wasting of the muscles is caused, and relaxation of the spinal ligaments. Lateral curvature is less frequent in the lower orders because stays are less worn, and for the same reason boys are seldom if ever affected with this form of curvature[s]."

"In some finishing schools, according to letters published in the 'Englishwoman's Magazine,' it is the rule to put a new-comer, on her arrival, into tight-fitting stays, which are fastened at the back in such a way that the girl cannot undo them herself. In these stays she sleeps, and every morning the maid or the governess gives them an extra pull together, so that there is a daily increased pressure and corresponding diminution of waist until the desired circumference is attained. This desired circumference ought not to be over eighteen inches at the very outside, and to be truly elegant should not exceed fifteen and a half. Fifteen and a half is extra elegant; the blue riband among waist deformities not given to every one to attain[h]."

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[s] Broadhurst "On Lateral Curvature of the Spine."

A book called "The Corset and the Crinoline" has lately been written to defend the practice of tight lacing, and to prove that a small waist is the greatest beauty of the female form; and the writer even hints that men would do well to imitate the Prince de Ligne and Prince Kaunitz, who both encased themselves in expensively made corsets, and it is related as an interesting fact that the former wore black and the latter white satin stays.

The smaller diameter of the waist, or that from back to front, of the Venus de Medicis is 7¼ in., and the larger diameter is 9¾ in. If an oval be drawn according to these measurements, having for its larger diameter 9¾ in., and for its smaller 7¼ in., the circumference of this oval will measure 27 in., that is, three-sevenths of 5 ft. 2 in., which is the height of the Venus de Medicis if standing quite erect. According, therefore, to the proportions of this world-wide standard of female form, three-sevenths of the height ought to be the circumference of that smallest part of the torso, which is called the waist, and anything less than this will be out of proportion. These measurements also shew that the truly beautiful form of waist is oval, and not round.

It was the law in Sparta that no woman should marry until she had passed an examination in gymnastic exercises; and when we consider the immense influence of heredity, we can hardly help feeling a wish that a leaf might be taken from the book of Lycurgus, and copied into our own educational code. This great lawgiver ordained that each child, when seven years old, should be handed over to an officer of the state, who was charged to train them carefully in all gymnastic exercises. The girls received a physical education almost as thorough as that of the boys, and they were encouraged to contend with each other in wrestling, running, and even in boxing. The young men were permitted to be present when the maidens practised these exercises, and the youths of Sparta were stimulated by the smiles and applause of those whose good opinion they valued most highly, to undertake and accomplish the most arduous tasks. Though all this may have "shocked" the women of other Grecian states, whose manners and customs were more reserved, yet the Spartan women were as remarkable in that age for the purity of their morals, as for their superiority in health and beauty.

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[h] "Saturday Review," May 23, 1868.

The Spartan theory of government and education is, no doubt, directly opposed to the views which now prevail. Lycurgus held that each individual should live for the State alone, we, on the other hand, believe that the State exists only for the benefit of individuals. But whichever of these views, or whatever modification of them, we adopt, physical and also mental education must eventually be regarded as a *sine qua non* in the constitution of a perfect State.

"Ill fares the land, to hastening ills a prey,
Where wealth accumulates and men decay."

"It is plain that it is impossible to devise any sanitary measures which would do all that is required. It is not to be expected that the artizans in crowded cities, living in close habitations, and to a great extent indulging in intemperate and thriftless habits, can enjoy the robust health and physical powers of a rural population. There needs no other proof of this fact than the difference in the actual mortality of the two classes. Unfortunately it is shewn by the returns of the late census, that while there is a great increase in the larger towns, the population of the rural districts is diminished rather than otherwise. I own that I cannot contemplate such facts without some apprehensions as to the future. There may not be any great difference observable in a single generation, but is there not danger that, after a few generations more have passed away, the race will degenerate, and the mass of the population will no longer be distinguished for those powers of physical exertion, that unflinching determination to overcome difficulties, which have hitherto contributed so much to the power and welfare of our country[1]?"

In these modern days strong arms do not decide the fate of armies, and steam power is rapidly supplanting muscular power in every branch of trade. A charge of steam engines rather than of cavalry will probably be the greatest episode in future Balaclavas. Any narrow-chested dyspeptic little wretch is able to discharge a rifle with fatal precision from behind an earthwork. Men may degenerate into creatures like "little Tom Noddy" in the nursery rhyme, who was "all head and no body," and yet be able to live for a while, and to defend themselves by skill and ingenuity. In the struggle for life other species of animals require health and strength, but we seem to be approaching a phase of OUR existence when these auxiliaries will no longer be necessary. *Chacun a son gout.* We, of the athletic school, will, if possible, before this consummation is accomplished, originate a variety of our species which shall be characterized by fully-developed physical as well as mental powers.

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[1] "Psychological Enquiries." Sir B. Brodie.

It would not be at all difficult to demonstrate the intimate connection between purity of morals and bodily vigour. Though not a believer in the dogma attributed to the sect of muscular Christians, that the whole duty of man is to fear God and walk a thousand miles in a thousand hours, and though it may be too much to affirm that "health is a virtue," there can be no question that strong exercise is a great aid to virtuous living. Vigorous muscular exertion has a direct physiological effect in subduing the sensual passions, and it is well known that idleness and sedentary habits add fuel to the fire:—

"E'en from the body's purity, the mind
Receives a secret sympathetic aid[k]."

"The weaker the body the more it commands, the stronger it is the more it obeys[l]." Lord Stanley, when advocating athletic exercises, enforced this view in the following well-chosen sentences:—

"There are other evils of a purely sedentary life, to which, in this company, I can scarcely advert; one is, that physical feebleness leads to depression, that depression may be relieved by the easy and always accessible resource of drink, and then, sooner or later, we know the end. In other respects, too, medical men, and all who have studied health questions, will understand the vague phrases I have used. It is not easy to overrate the degree to which habits of morality among men under middle age are connected with healthy physical conditions, and, above all, with sufficient bodily exercise."

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[k] Thompson's "Seasons."

[l] Rousseau's "Emilius."

Ethical teaching has hitherto been confined mainly to the inculcation of the duties which we owe to our neighbours, duties of *acting* rather than of *being*, but the doctrine of culture is now shewing us that there are also most important duties which we owe to ourselves alone; and much of the reasoning used to convince us that mental culture, that the acquirement of "sweetness and light" is a positive duty, can be applied to enforce, with equal power, the duty of cultivating our physical endowments; indeed, the attempt to perfect one without the other is a mistake of the gravest character.

Muscular activity, apart from its indirect effect in promoting happiness through health, is one of the purest and keenest of pleasures, and is perhaps the most certain remedy for

> "The heart-ache and the thousand natural shocks
> That flesh is heir to."

The extent of this agreeable sensation may be known, as Bain points out—

"Not only by its surpassing many other pleasures when brought into comparison, but also by the extent of pain and irritation capable of being subdued by it. This last circumstance has great importance in many ways; there is hardly anything so much resorted to as muscular exertion for quenching states of pain[m]."

That keen observer of human nature, the authoress of "Adam Bede," has noticed the latter fact, and the writer of this Essay can confirm, from his own experience, her assertion that there is nothing like a good gallop across country for exercising the demon of ill-temper, and other kindred spirits.

Exercise should be taken in such a way as to be a pleasure rather than a task. Dr. Combe has clearly shewn that unwilling and reluctant labour does not act beneficially on the limbs or muscles employed, but is, on the contrary, injurious and destructive of them, as is seen in the case of convicts compelled to labour in prisons, and it is on this account that prisoners on hard labour require a liberal diet to maintain them in tolerable health.

It is only muscular or mental work which results from *an effort of the will,* that is followed by fatigue, and therefore the less the effort of volition required to accomplish any matter, the less is the feeling of fatigue which follows. "The essential part of sleep is the suspension of volition[n]." We rise from a night of sleep, during which our imagination and involuntary muscles have been actively employed, perfectly rested, and refreshed.

Facts such as these seem to indicate that exhaustion of brain force is the cause of *all* weariness, and they appear to confirm the theory of Radcliffe and others, who hold that the brain and nerves are almost identical in their mode of action with an electric apparatus of wires, charged jars, &c.

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[m] "The Senses and the Intellect." Bain.

[n] Darwin.

Sir B. Brodie compares the action of oxygenized blood on the brain tissues, to the production of electric force by the action of an acid solution on the metallic plates in the cells of a voltaic battery [°]. And, to continue this digression, the process of electro-plating greatly resembles the assimilative selection of nutritive materials from the blood by the tissues.

Many men who readily admit the necessity of active exercise have the most hazy notions on the subject. One, for instance, after wrapping his delicate carcase in a great coat and comforter, thrusting his feet into huge goloshes, and, perhaps, placing cotton wool in his ears to keep out the air, arms himself with an ample umbrella, and shambles off for a trudge of two or three miles along some dreary turnpike road, his mind engrossed by thoughts of the shop left behind, and thus he takes his "constitutional" as reluctantly as he would a dose of some other disagreeable, but salutary physic. And there are thousands, including even medical men, whose ideas of efficient exercise are as crude as those of the ridiculous old "fogey" just described. To quote from Lord Stanley's speech once more:—

"Life passed within four walls during the week, with only the variety of a walk on Saturdays and Sundays,

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[°] "Psychological Enquiries."

will very seldom be a healthy life in a true sense. For by healthy, we mean, or ought to mean, not the mere absence of disease, nor the mere capacity to go through an ordinary day's work, *but that state in which existence itself is felt to be an enjoyment, in which all simple and natural pleasures are appreciated, and the little every-day anxieties of our business sit lightly upon us.* If there are, as is undoubtedly the case, classes among us who run all to muscle, and with whom the brain never gets a *chance* of being developed—navvies, ploughmen, and the like—so there are classes who seem to have no further idea of using their muscles than is implied in walking to their place of business (and very often they take an omnibus to save the time), and whose utmost bodily exertion is driving a pen for hours together, and handling their knife and fork at dinner. Now I say, and I hope without offence, that in the latter class the human result is to my mind hardly more satisfactory than the former. Take your navvy and you have a fine sample of animal development, but I am afraid you have very little else. Take your clerk, shut up from year's end to year's end, you have a quick active brain, and a nervous system over excited, but the animal frame feeble and badly developed,—I am speaking, of course, of what men may become who do not attend to their bodily requirements."

Exercise should be varied as much as possible. Mere walking is quite inadequate; running is much better, because it brings into play, not only the muscles of the lower extremities, but also those of the back and chest, and especially because the muscles of extraordinary respiration are made to act, causing complete inflation of the lungs and expansion of the chest. Other exercise must be combined with running, to develope the arms and shoulders, which are not sufficiently worked in this motion, otherwise the upper would lose while the lower limbs gained in strength.

The undeveloped arms of the celebrated runner, Deerfoot, contrasted remarkably with other parts of his stalwart frame.

It is varied exercise that gives the perfect command over our motions, by which we are enabled to act rapidly and without hesitation; this power may be described as "presence of body," and it probably forms, as Mr. R. Evans asserts, a great part of that quality so serviceable in situations of danger, called "presence of mind." The manner in which some professional players of dance-music accomplish their task without, apparently, any direction from the will, their instruments giving forth no uncertain sound, though their attention is absorbed by the incidents of the ball-room, affords a good example of what is meant by "presence of body." And it is the absence of the perfect command over their muscles which results from varied exercise that unfits sedentary persons, and those occupied with abstract speculations, for that brilliant display of control over the present, which is commonly called presence of mind.

Mr. Hully states that the increase of chest measurement resulting from "very moderate systematic exercise, averaging three times a-week, has ranged from *two to six* inches in twelve months, the improvement of other parts of the body being proportionate;" this estimate is deduced from 500 examples; and Maclaren, of Oxford, declares that two inches additional in girth of chest is obtainable in the *first* term of practice at his gymnasium by growing young men coming up to Oxford from school.

Running exercise should be enjoined with the ordinary course of instruction at gymnasia, for girth of chest may be increased by slow and regular exertion, which will develope the muscles without proportionately adding to the aërating capacity of the lungs. Improved "wind" represents, chiefly, increased power of the respiratory muscles resulting from their exercise, with a corresponding change in the *bones* and other firm parts of the chest. It is probable that in ordinary respiration the inspiratory and expiratory forces nearly counterbalance each other, whilst in healthy forced expiration the muscular power exerted is very much greater than in inspiration. There is reason to suppose that the aërating surface of the lungs is augmented by running and other exertions, which cause a demand for rapid supplies of oxygen.

The *available* muscular force of any individual depends as much upon respiratory capacity as on the collective power of the muscles of his body.

The following table shews the average capacity of the lungs as noted by Dr. Hutchinson in a large number of cases of healthy adults whom he examined with the spirometer:—

Height.				*Capacity in Health.*
FT.	IN.	FT.	IN.	
5	0	5	1	174
5	1	5	2	182
5	2	5	3	190
5	3	5	4	198
5	4	5	5	206
5	5	5	7	222
5	7	5	8	230
5	8	5	9	238
5	9	5	10	246
5	10	5	11	254
5	11	6	0	262

Example:—A man of 5 ft. or 5 ft. 1 in. should breathe 174 cubic inches of air at one expiration.

It appears from this table that 8 cubic inches extra lung capacity is gained for every inch of stature.

These averages fall far short of the lung capacity of robust health, and those who take sufficient systematic exercise will much exceed these estimates, which were made, together with the following tabulated observations, while studying the changes produced by lung disease in the breathing power. They do not, of course, teach us what *ought to be, but what is,* the average relation between height, weight, and vital capacity.

Stature.		Mean Wt.		Wt. increased by 7 per cent.	
FT.	IN.	ST.	LB.	ST.	LB.
5	1	8	8	9	2
5	2	9	0	9	9
5	3	9	7	10	2
5	4	9	13	10	9
5	5	10	2	10	12
5	6	10	5	11	1
5	7	10	8	11	4
5	8	11	1	11	12
5	9	11	8	12	5
5	10	12	1	12	13
5	11	12	6	13	4
6	0	12	10	13	8

Example: A man of 5 ft. 1 in. *generally* weighs 8 st. 8 lbs., but, he may weigh 9 st. 2 lbs., without affecting his vital capacity; beyond this weight his respiration becomes diminished.

The weight may increase from a large deposit of fat, or by the addition of substance to the bones, muscles, or other tissues. But it is only when we are fattening that we gain in weight without at the same time increasing the aërating power of our lungs. Adipose matter, by collecting in and between the intercostal muscles, even hinders respiration, causing the ribs, particularly the upper ones, to become fixed, and thus preventing the thorough expansion of the chest.

The hare, with many other animals remarkable for fleetness and strength, has no fat; and any considerable quantity of this substance in the human body is a mechanical obstacle which interferes with the action of the muscles, and adds weight without yielding power. It is well known that men and horses with large bellies are short-winded; their respiration is impaired by large collections of fat deposited upon the intestines; this prevents the efficient contraction of the abdominal muscles, by forming a soft cushion upon which their action is almost entirely expended.

To judge of the effect produced by a course of physical training, we must examine the muscles; they should be hard, well-marked, and not covered by fat—

> "Beneath the white skin to and fro,
> Glancing the steely muscles go;
> On trunk and limbs the sinews show
> Like ivy-stems on oak."

The vital capacity of the chest must be measured, and the condition of the skin should be noted; a clean tongue, a healthy action of the bowels, clear bright eyes, and high spirits, are other indications of improving health and successful training. The relation between the condition of health and the appearance of the skin is seen in those who are badly fed, or who suffer from dyspepsia in the less acute stages. Under the skin an extensive network of small nerves is spread out, and through them we may readily act upon the nervous system generally, by means of hot and cold baths, friction, and the like. These small nervous ramifications have, doubtless, a powerful influence on the skin, and make it an unfailing index, to the experienced eye, of the state of the general health.

Muscular firmness or tone is an indication, not only of strength in the muscles, but also of health throughout the whole body. This passive or tonic contraction differs widely from the active contraction which takes place under the direction of the will, being general and uniform throughout the length of each fibre, instead of being partial, momentary, and successive, in each sarcous particle, not absent during rest but merely in equilibrio. The close correspondence of this phenomenon with the condition of the general health and its evanescent character (for a day of dissipation, or a sudden access of strong mental emotion will abolish it for a time) indicates the difference between this tonic contraction and voluntary muscular action. Nurses augur health and strength for those among their infant charges whose testicles are firmly braced up by the scrotum, and this bracing up is due to the tonic contraction of certain fibres of muscle in the skin covering those organs. We are guided in our estimation of the ill-health of our friends, as expressed in their faces, by noting the flabby and relaxed appearance of those slighter and more fugitive lineaments which so largely affect the physiognomy for the time; the muscular tone upon which depends the sharpness and distinctness of these lineaments has been, in the case of our ailing friends, temporarily impaired.

Let any of my readers observe carefully his or her own face after a sleepless night, and compare its appearance before and after the application of cold water.

An extract from the register of Maclaren, of Oxford, is given below, which shews the results of gymnastic exercise, gauged by measurements. But increase of size does not indicate very accurately the amount of muscular power gained by exercise; many men will almost double their original strength without shewing the improvement by any very perceptible increase of size.

Case	Date.	Age.	Height.	Weight.	Chest.	Fore Arm.	Upper Arm.	Remarks.
H	Oct., 59 June, 60	20	5ft. 0½in.	7st. 1lb. 7st. 8½lb.	29in. 31½in.	8in. 9½in.	8¼in.	Imperfectly developed but not constitutionally delicate, the attendance very irreg. in last term.
R	Oct., 59 Oct., 60	19	5ft. 2½in. 5ft. 4½in.	8st. 0lb. 8st. 5lb.	30½in. 34¼in.	9in. 9½in.	9½in. 10½in.	Well proportioned.
P	Oct., 59	19	6ft. 1½in.	12st. 1lb. 12st. 4½lb.	35½in. 40in.	10¾in. 11in.	11¼in. 12½in.	Of large and strong frame but heavy and inactive.
B	Oct., 59	17	6ft. 0in. 6ft. 0½in.	9st. 4lb. 9st. 13lb.	30½in. 34½in.	2¾in. 9¾in.	9¼in. 10½in.	Delicate frame, chest flat and narrow, with the sternum much depressed.
T	19 May, 60 21 Jun., 60	17	5ft. 4in. 5ft. 4¼in.	8st. 0lb. 8st. 6lb.	31in. 32¾in.	9in. 10in.	9in. 10¼in.	Delicate frame, physical powers subdued by severe work and confinement.
A	57 58 59	19 20 21	5ft. 10¾in. 5ft. 11in. 5ft. 11½in.	10st. 2lb. 11st. 0lb. 11st. 6lb.	35½in. 38½in. 40in.	10¼in. 11¼in. 11¼in.	11in. 13in. 13½in.	Powerful frame and great energy.

Not quantity only, but *quality* of muscle, must be considered in estimating athletic prowess. This difference of quality is very strikingly exhibited among the lower animals. The leg and arm of an ape, baboon, or gorilla, is very thin, small, and light, yet the strength of these animals is almost incredible; in insects the same disproportion between bulk of material and available power is even more plainly seen.

M. F. Plateau, in *Revue Suisse*[p], shews that the common cockchafer can overcome a resistance equal to fourteen times, and the *Donacia nymphea* a resistance equal to forty-two times, its own weight. This is greater exertion than any vertebrate animal can make, but, as Bergman has shewn, the relation between the motor power of an animal and the mass of its body is unfavourable in proportion to its size, the weight augmenting as the cube; the motor power, measured by the section of the muscles, increasing only as the square[q].

The following fact, vouched for by Professor Goss, gives a good notion of the beetle's immense muscular power, a creature whose bulk of animated substance is even less than it appears to be :—

"This insect has just astonished me by its vast strength of body. When brought to me, having no box immediately at hand, I was at a loss where to put it till I could kill it, but a quart bottle of milk being on the table, I placed the beetle for the present under that, the hollow of the bottom allowing him to stand upright. Presently, to my surprise, the bottle began to move slowly and glide along the smooth table, propelled by the muscular power of the imprisoned insect, and continued for some time to perambulate the surface, to the astonishment of all who witnessed it. The weight of the bottle and its contents would not be less than three pounds and a-half, while that of the beetle was about half-an-ounce, so that he really moved a weight 112 times his own. A better notion than figures can convey will be obtained of this fact by supposing a lad of fifteen to be placed under the great bell of St. Paul's which weighs 12,000 pounds, and to move it to and fro on a smooth pavement by pushing within."

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[p] *Sur la force Musculaire des Insectes*, v. 2, 1866.

[q] "Biennial Retrospect," 1866.

Another proof that there is varying quality in muscle exists in the discovery, by Knorz and Henke, that the muscles of the arm are proportionably stronger than those of the leg, as 13 is to 17.

How often have we seen astonishing feats of sheer strength and agility performed by men whose small slight frames gave no promise of the force that was in them, while others have deceived us by proving themselves utterly unable to accomplish a task, which should have been easy to men of such herculean proportions. The writer of this essay also believes that strength depends as much upon the stimulus which is given by a powerful nervous system, as upon the size and quality of the various muscles. The great strength which persons in a mesmeric state are said to exhibit may be accomplished by the direction of the whole nervous power, through the concentration of the will, to one object. The immense force sometimes exerted by madmen in their struggles is perhaps another example of intense nervous stimulus bringing out the whole mechanical power of the frame. Again, some may be candid enough to confess that fear has added most marvellously to their fleetness when seeking safety in flight from the attack of that "stock incident of fiction" an infuriate bull.

Victor Hugo, describing the hero of his splendid novel "The Toilers of the Sea," says, that "his biceps was no more powerful than that of ordinary men, but his heart was firmer." By a determined direction of his will he concentrated the entire strength of his muscular and nervous systems upon the obstacle to be overcome; but however determined his will or firm his heart, his object could not be attained without the force evolved from material tissues, nervous and muscular.

The thoroughbred horse appears to be an example of both quality of muscle and of nerve power; and it is in quality rather than size of muscle that gentlemen would perhaps be found to excel. In Napoleon's disastrous retreat from Moscow it was noticed that "the officers always stood out longer than the men."

Now the conditions essential to the maintenance of health, and therefore to successful physical education or athletic training, are

1. Sufficient and appropriate Food.
2. A due amount of Exercise.
3. Pure and Fresh Air.
4. Sufficient Rest.
5. A free use of Cold Water.
6. The avoidance of things which are injurious.

We must have some acquaintance with the subjects comprised under the foregoing heads before we can form a reliable system in developing our physical powers; and as none of these conditions are more essential to health and strength than the first enumerated, this essay would be very incomplete if the subject of diet had been altogether neglected, especially as the most rudimentary knowledge of the chemistry of food is a very rare possession. From this ignorance of the principles of diet, a family may be under-fed while having the command of the most ample means—though they may consume large quantities of food, the amount of nutriment obtained by each may still be, and often is, insufficient. There is reason to believe that thousands of children are killed yearly by mistakes arising from want of knowledge of the nutritive value and various properties of foods. Hospital physicians and surgeons, who see much of the poor, cannot fail to remark the extent of this evil among them.

"It is to diseased nutrition, however brought about, that we may refer the production of tuberculosis (the blood disease which produces consumption, &c.); and it is to insufficient, innutritious, or improper food, that the vast majority of cases of diseased nutrition are due, though it may arise from impure air, want of cleanliness, and of healthy exercise[r]."

Absolute want is perhaps the greatest cause of disease in many large towns, but this would be much diminished if there was less ignorant waste of food among the wealthy, and if some little knowledge of dietary principles could be given to the poor.

Might not some instruction of this kind be given in National Schools? The girls could there learn what articles will yield the most real food at the least cost, and such knowledge would be far more useful to them, when they came to be wives of working men, than the highest skill in fancy-work of divers kinds, which often occupies their precious time in the hours of school. Tables of the following kind might be drawn out for the use of these mothers *in futurum esse.*

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[r] Tanner, "Practice of Medicine."

Money value, and quantity, of different foods required in the production of one pound of human muscle :—

4½ lbs. of butcher's meat, cost, at 6d. per lb.,	2s. 3d.
6 lbs. of flour, at 1d.	6d.
3 lbs. of peas or beans, 1d.	3d.

"Till, indeed, both rich and poor understand better the laws of health, and put more extensively in practice the discoveries of science in relation to the wisest way of dealing with themselves physically, we must be prepared to witness enormous waste not only of food and money, but of the bodies and souls of men. And it is in vain to discuss, except in some special circles, the æsthetics of taste, while the very alphabet of diet remains unmastered[*]."

Food.

Food should only be taken when the natural feeling of hunger is experienced: we may and do regulate the recurrence of this sensation by habit; it is, therefore, important to decide what intervals should divide one meal from another. Dyspepsia or indigestion results, in the majority of cases, from burdening the stomach with aliment before it is ready to renew its labours, or from taking two meals at once after a long fast, which is a practice common enough among London merchants, lawyers, and other eager men of business, who will not allow themselves time for a dinner or substantial luncheon in the middle of the day.

The rule of Abernethy was that at least six hours should intervene between each meal; he endeavoured to impress upon his patients the absolute necessity of studying these things, but he once declared that no person could be induced to pay sufficient attention to his feeding until death, or the dread of death, is staring him in the face. This is a very discouraging assertion, but let us continue the consideration of this matter in the hope that he was mistaken.

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[*] "Five Gateways of Knowledge." Wilson.

The formation of the gastric juice is a process of cell-growth, which requires an interval of four or five hours for its completion, and from this we conclude that Abernethy's rule is a good one to follow. In young children this cell-growth, like all other growth in them, is much more rapid, therefore they require to be fed more frequently than adults.

Food should not be taken, in any large quantity, soon after severe exercise of either a mental or bodily kind, as a determination of blood takes place to the organs employed, during, and for some time after, any great exertion. The nutritive fluid would thus be drawn away from the stomach, which requires a vigorous circulation of blood in its parieties while performing its functions. It is therefore best to wait and rest for a short time, until the balance of the circulation is restored. A cup of tea is valuable at such times, preparing the stomach for its duties by recalling to it the current of blood.

Unless food is well masticated and mixed with saliva in the mouth, the digestive process will be much retarded. The pain which some persons experience after their meals, meals from which indigestible food has been carefully excluded, is frequently due to the habit of bolting their victuals, which many unconsciously acquire. Dr. Beaumont and others have clearly proved that a thorough mastication and insalivation not only prepares the food to be swallowed and facilitates the action of the gastric juice upon it, but also that the saliva, when intimately mixed with vegetable aliments, acts chemically upon them, instantly changing the starchy constituents into sugar. Saliva stimulates the gastric secretion, and this latter fluid, in its turn, causes a flow of bile and of pancreatic juice into the stomach.

Persons whose teeth are so defective as to interfere with mastication should take their food in a soft or minced state.

When the salivary glands are not abnormally stimulated by the irritation of tobacco smoke, or other deleterious influences, to a wasteful activity, the average secretion of saliva daily amounts to about forty-five ounces.

CHEMISTRY OF FOOD.

Analysis is a term which signifies the process of resolving any compound thing into its ultimate elements.

There are sixty-two substances known which are not at present susceptible of further analysis; these are therefore called elementary bodies.

Twenty of these elementary substances are found in organized beings; eleven of them are non-metallic, and nine are metallic[t].

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[t] The non-metallic are oxygen, hydrogen, nitrogen, carbon, phosphorus, sulphur, chlorine, fluorine, bromine, iodine, and silicium.

The metallic are sodium, potassium, calcium, magnesium, cuprum, aluminium, iron, and lead.

We should, according to the generalization of M. Dumas, regard every animal as an apparatus of combustion, which, by inspiration, obtains oxygen from the atmosphere to keep the lamp of life continually burning. The food taken by an animal is constantly burning away in the lungs, or in the tissues—wherever the blood yields up its combustible matters to unite with the oxygen inhaled from without.

Animals, through their lungs, return to the atmosphere carbonic acid, nitrogen (in the form of oxide of ammonium), and hydrogen (united with oxygen to form watery vapour).

The union of oxygen with carbon or hydrogen produces the phenomenon of combustion.

It is the great predominance of carbon in organic compounds which gives them their characteristic tendency to oxidation or combustion in the open air.

Vegetables separate from the air the substances thrown into it by the respiration of animals, and they then pass into the bodies of herbivora again in the form of plant tissues.

The nine metallic substances which form part of organized beings pass again and again through their systems, but they are not burned in the lungs; they correspond to the ashes of an ordinary fire, and are excreted in the fæces and urine. These metallic substances are chiefly assimilated from water, by plants and animals.

Plants obtain for us from the earth that food which we are not able otherwise to extract from it. Will not chemistry some day be able to do this office for us without the intervention of agriculture?

The constant changes above described constitute what Dumas has called the chemical balance of organic nature.

In all animal and vegetable tissues carbon, hydrogen, oxygen, and nitrogen, greatly preponderate. These elements we get directly from plants, or indirectly, by eating the flesh of herbivorous animals, but vegetables do not yield these to us in a simple form ; they are united in plant tissues, and also in the flesh of animals, with other organic elements, to make what are called

1. The nitrogenous, or azotised, or histo-genetic foods, viz. albumen, fibrine, and caseine.

2. The non-nitrogenous, or carbonaceous foods, viz. gum, starch, sugar, fat, and oil.

The albumen of plants and of animals is identical. The substance which is called fibrine, when derived from animal tissues, differs in nothing but its derivation from the gluten of plants. Caseine is that part of milk from which cheese is made, and vegetable caseine, or legumine, so nearly corresponds to the animal product, that the Chinese make from this a kind of vegetable cheese, without having, however, discovered its identity with milk cheese.

The *Leguminaceæ*, or podded plants, contain about twenty-five per cent. of vegetable caseine. Albumen, fibrine, and caseine, are called the nitrogenous constituents of food, because they all contain fifteen per cent. of nitrogen or azote, while gum, fat, starch, and sugar, have no nitrogen in them. Again, the former class of foods are distinguished as histogenetic, or tissue-forming, because they are the materials from which the muscular and other tissues of the body are mainly nourished, while the substances last enumerated are classified as carbonaceous, because this element abounds in them, and it is their part to supply fuel for animal combustion.

The union of oxygen inspired from the outer air with the carbon and hydrogen carried by the blood to the lungs, is accompanied by the evolution of heat, and this is said to be the main source of the animal heat of the body, which does not fall below 98° (Fahrenheit) when in a condition of health.

The carbon of food, (which is identical with charcoal,) when burned in the body, gives out just as much heat as it would if consumed as charcoal in a stove; in the former case the combustion is merely distributed over a larger space of time. Animals that hybernate become very fat before winter sets in; they require little or no food to repair the waste of the tissues, which is exceedingly small in a dormant and motionless state; but a certain temperature is necessary to the maintenance of life, and to supply the body with this requisite amount of heat the store of fat is gradually burnt off during their hybernation. But there are many facts which make it certain that the non-nitrogenous foods are not merely heat-givers, as is commonly thought, and as Liebig maintained. Fat enters largely into the composition of brain and nerve substance, and it will probably be found that one of its most important uses is the nourishment of the brain and nervous tissues. One fact which points in this direction may be mentioned here; fat is found in the urine of the chronically insane, but not in healthy urine. Professor Donders, of

Utrecht, considers that the non-nitrogenous and the azotised foods are equally necessary for muscular work [u].

Fibrine, (or a substance differing very slightly from it called cyntonine,) forms the chief part of muscular fibre.

Albumen, which exists nearly pure in the white of egg, is the main constitutent of nerve substance.

Gelatine, an albuminous substance, is the organic portion of bone; it is also found in the tendon and other tissues.

It is, then, from this group of azotised substances, that the animal body, with its bones, muscles, nerves, arteries, veins, and viscera, is chiefly built up, and these materials must be constantly supplied in the food to repair the perpetual disintegration of these parts, which constitutes the "wear and tear" of organized life.

The individual members of each group of foods may readily be transmuted in the system according to its requirements; thus starch is changed into sugar, or caseine into fibrine, but Playfair holds with Liebig that the carbonaceous aliments cannot in this way become nitrogenous.

The main bulk of the frame consists of water; the body of a man weighing eleven stone would contain 111 lbs. of this fluid.

An animal weighing 130 lbs. would yield, according to Bidder and Smidt, upwards of four pounds of nitrogen.

Just at this time it is a *vexata quæstio* in physiology whether the combustion which keeps up the bodily heat occurs principally in the lungs, or in the tissues at the points of disintegration. Professor Donders is of opinion that the bodily heat is for the most part developed in and through the muscles by chemical action. Wherever there is capillary circulation, arterial blood is becoming changed into venous, and oxygen is chemically combining, accompanied by the evolution of heat[1]. Mayer, of Hielbronn, maintains that *all* oxidation or combustion occurs in the blood, and that all force is developed there. In this view he is ably supported by Mr. W. C. Heaton in the "Philosophical Magazine," (May, 1867).

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[u] "On the Constituents of Food, and their Relation to Muscular Work," &c., 1866.

It is reckoned that the amount of caloric evolved in the body of a full-grown man amounts to sufficient in the course of a year to heat from 20,000 to 25,000 lbs. of water from the freezing to the boiling point.

Clothing and feeding, it will be at once perceived, are closely related, for of course abundant clothing will lessen the demand for carbonaceous foods, while the absence of external warmth will increase it. The inhabitants of extremely cold countries instinctively consume great quantities of animal fats, and thus a rapid and large supply of carbonaceous material is afforded to keep up the heat of the body.

Comparative anatomy plainly shews that man is designed to subsist on a mixed food, part animal and part vegetable, one or the other preponderating according to the many different climates of the inhabited earth. The

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[1] "On the Constituents of Food, and their Relation to Muscular Work and Animal Heat." Utrecht, 1866.

Esquimaux will devour with great gusto almost incredible quantities of whale's blubber, and the Russian's taste for tallow candles is rather due to the influence of climate than to national gastronomic depravity,—experience has taught them the advantage of eating largely of soft hydro-carbons as a protection against the cold, and also as a corrective of the great quantity of bread they eat, viz. 3 lbs. per diem, *ordinarily*, and 2 lbs. more during harvest, besides kasha, or hash of vegetables and eggs. They prefer rye bread, and this is fried in linseed, or sunflower oil, before being eaten. In these cold countries much of the nitrogenous, or flesh-forming part of the food is consumed in producing heat, if carbonaceous aliments be not freely obtainable, and in this way great waste of force and of material sometimes occurs. The hunters employed by the Hudson's Bay Company, when no vegetables are to be got, are allowed from 8 to 10 lbs. of flesh-meat, but only 2 lbs. of meat is required per diem when a pound of corn-flour is added to their rations. The quantity of carbon expired per hour by a robust man in good health, living in England, is, according to Dr. E. Smith, as follows:—

	oz.	grs.
While sitting still	9	0
Walking at 2 miles per hour . .	18	1
Walking at 3 miles per hour . .	25	8

A man of the middle class, with the usual amount of exercise, breathes 8 oz. 8 grs. of carbon daily.

A working man, doing a fair day's work, expires 11 oz. 5 grs. of carbon, and to burn off this quantity, about 27 oz. of oxygen is consumed. To obtain this necessary amount of oxygen, a supply of twenty cubic feet of fresh air per minute is needed[y].

Too much carbonaceous food checks the nutrition of the muscles and encourages the development of fat; hence rice feeders, potatoe eaters, and drinkers of fermented liquors, are often bloated in their appearance, and are seldom able to endure prolonged exertion[z].

In respect to food, as in other ways, man possesses extraordinary power of adaptation to the exigencies of his geographical situation, but he obtains the greatest mental and physical perfection in countries where the supply of both kinds of food is abundant, and there can be little doubt that a people's material and moral greatness depends, in a very great degree, upon the quantity and quality of the food which they obtain. We already know that there is an intimate connection between food and work, whether muscular or mental, but we are not yet in a position to demonstrate that the same relation exists between food and thought, as exists between food and physical action. The aspirations of science in this direction were expressed on a recent occasion by the Rev. Prof. Haughton in the following eloquent sentences:—

"From the time of the publication of Bichat's 'Essay on Life and Death,' it has been admitted that man and other animals possess a double life, *animal* and *organic*, presided over respectively by two distinct, though correlated, centres of nervous force; of these, one *thinks*, *moves*, and

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[y] Dr. E. Smith.

[z] Aitkin's "Science of Medicine."

feels; the other merely *cooks,* receiving the food supplied, changing and elaborating it into elements suitable for the use of the animal life.

"In the lower forms of animals, the organic life becomes almost co-extensive with the whole being of the creature, which simply digests, assimilates, and excretes, but barely feels or moves. In the higher forms of animals, and more especially in man, the animal life dominates over the organic life, which becomes its slave; and it exhibits the remarkable phenomena of *mechanical force,* of *geometrical instinct,* of *animal cunning,* and finally, in man himself, produces *intellectual work,* rising to its highest form in the *religious feeling* that recognises its great Creator, and bows in humility before Him. It is a simple matter of fact, and of every-day observation, that all these forms of *animal work* are the result of the reception and assimilation of a few cubic feet of oxygen, a few ounces of water, of starch, of fat, and of flesh.

"The general question of the relation of food to work would involve a consideration of the possibility of throwing a bridge across the gulf that separates the organic from the animal life, so as to connect the products of nutrition (taken in its widest sense) with the work of every kind accomplished by the animal life, whether mechanical or intellectual. We resemble the spiders of the heather on a summer morning, that float their gossamer threads into the air from the summit of a branch, in the hope that some stray breath of wind may fasten it to a neighbouring tuft, and enable the hungry speculator to extend the range of his rambles and his chances of food. Already a few feeble threads connect the chemistry of our food with the *mechanical work* done by our muscles. When these have been securely fastened, from the higher vantage-ground acquired, our little bridge of knowledge may possibly be extended to embrace the phenomena of the geometrical instinct of the bee or the cunning of the beaver; and our successors may even dare to speculate on the changes that converted a crust of bread or a bottle of wine, in the brain of Swift, Molière, or Shakespeare, into the conception of the gentle Glumdalclitch, the rascally Sganarelle, or the immortal Falstaff. At present, such thoughts would be justly regarded as the dreams of a lunatic, and I must claim your indulgence for having mentioned them. The history of science is, however, filled with such dreams; some never realized, others converted by time into realities so commonplace that the genius of their originators is habitually forgotten or underrated."

Dietaries.

Dr. Christison has found, from observations made upon large bodies of men, that the best dietary is one which contains carbonaceous and nitrogenous food in the proportion of three of the former to one of the latter by weight.

On an average a man requires 6 or 7 oz. of chemically-dry nitrogenous food to supply the daily waste of an active life, and, according to the proportion laid down by Christison, he will also require from 18 to 21 oz. of chemically-dry heat-giving food. This is a larger quantity of carbonaceous matter than we should, from the experiments of Dr. E. Smith, have been led to expect.

Though these calculations accurately indicate the average, they by no means shew the maximum required for the development of the full powers of mind and body. To keep up the athletic constitution, 36 oz. of *real* nutriment is required.

It is one thing merely to support existence; it is quite another thing to generate sufficient cerebral nervous and muscular force for the proper discharge of the duties, and appreciation of the pleasures, of life.

A Birmingham prize-fighter was examined by Dr. Percy during a course of active training. This pugilist weighed 8½ stone and measured 5 ft. 6 in. in height. He walked seventeen miles daily and ate 1 lb. of mutton at each of his three meals, and 2 oz. of bread with the meat at dinner. With each meal he drank half a pint of ale. Thus he took 50 oz. of food daily, and the real aliment contained in this costly, wasteful, and insufficient diet was about 10 oz. of flesh-forming matter and 11 oz. of heat-giving food.

The other extreme would be well represented by the case of a shoemaker mentioned by Christison, who lived on the following diet for three months, at the end of which time he was attacked by scurvy:—For breakfast, one pennyworth of bread and tea, without milk. No dinner. In the evening his supper consisted of another pennyworth of bread, and again tea without milk.

It has been ascertained from authentic dietaries that the average quantity of flesh-forming principles in the food of agricultural labourers is less, by one half, than is required by an able-bodied workman[a]. Under such circumstances an adequate day's work can never be obtained from them. This insufficiency of food is as much the result of ignorance of the true value of food as of poverty. One thousand pounds, expended with a due regard to the *real* nutritive value of dietary articles, would support four times the number of people that it maintains when spent in the ordinary hap-hazard manner of cottagers. When more than the necessary quantity of nitrogenous food is taken, it is excreted mainly by the kidneys in the form of urea and uric acid. Nitrogenous substances, when fully oxidised, are reduced to the compound known as urea. According to Liebig, when the vital force in the albuminous tissues is not able any longer to resist the action of the oxygen which is carried to them by the blood, their elements combine with it and form various products, the chief of them being uric acid. But if sufficient water and oxygen be contained in the arterial blood, most of the more insoluble uric acid is converted into urea and carbonic acid. It will be seen that the more oxygen enters a tissue during disintegration the more complete will be the conversion of the insoluble uric acid into soluble urea. Much nitrogenous food and a disproportionately small amount of work will therefore produce an excess of imperfectly oxygenated uric acid in the urine, which, besides being a waste of material and of force, is frequently the cause of disease, constituting a tendency to gout and rheumatism.

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[a] Vide "Poor Law Reports." Mott, Chadwick, &c.

On the other hand, an excess of the hydrocarbons or non-azotised matters in the diet disturbs the balance between the hepatic and pulmonary excretions. It is the duty of the liver, as Bernard has shewn, to prepare the hydrocarbons for combustion, and if these are not burnt off with sufficient rapidity, the liver becomes gorged with its secretion and biliousness ensues, and it is in this way that Europeans in India, who eat and drink as if they were still in a temperate climate, get diseases of the liver for which they blame the country, though the true cause of their ailments is rather the common ignorance, or careless disregard, of dietary principles which prevails both at home and abroad.

Though, in many persons, a too liberal allowance of carbonaceous foods causes hepatic derangement, in others the only effect produced is an increasing accumulation of fat. The weight of a full-grown man in health varies very slightly, if at all, provided his labour be not increased or diminished, and a sufficient diet will exactly replace the daily waste and keep up the weight of the body. Frequent weighing is therefore a good test of regimen.

It is in the proper proportioning of the animal and vegetable aliments, according to their general and individual properties, with a due regard to the amount of work done by the consumer, that a true system of diet will be found.

To assert that instinct should guide us is absurd when we have long since renounced the guidance of nature in this as well as in most other matters. An artificial mode of living has deprived us of natural guides, and we must now look to science to lead us on in the new paths.

It is true that instinct has occasionally anticipated the revelations of science. The ploughman's favourite dinner is a mess of beans and bacon, and it would be difficult to discover a better or cheaper dinner for him, the vegetable yield the azotised, and the animal the carbonaceous, food. To this instinctive choice science lends her sanction. But when Hodge's wife provides for his dinner a red herring and potatoes, not because he prefers this, but because they believe it to be the cheapest fare, then only science can guard them against such erroneous selections. When our bucolic friend does follow "the promptings of his nature, an unerring instinct" leads him straight to the nearest public-house, but does not lead him home again; this is done by his unfortunate wife, after his week's earnings have been squandered.

The common name for all fermented liquors in the northern manufacturing districts is the word "nourishment," and as foods they rank, in their estimation, far above beef or bread.

No absolute rule can be laid down as to the quantity of food required; this varies greatly even in individuals of the same weight and size, and in the same persons at different times, according to climate, more or less mental or bodily work, and other smaller considerations. Race and habit have, undoubtedly, some influence in determining the quantity of food consumed. Ross informs us that an Esquimaux of dwarfish size will eat 10 lbs. of meat at a sitting, washed down by the same quantity of oil[b]. The Yakote are all fine feeders; there is trustworthy evidence of two Yakote having eaten 54 lbs. of mutton at one meal. They remain in a state of torpidity for some time after these great feeds, and their friends roll them about for exercise and to assist digestion; some of them, however, shew few signs of inconvenience, though their general profile is most unmistakeably altered. Cochrane states that he has seen three of these people eat up a reindeer at one meal.

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[b] Ross's Voyage (1835); Parry's Voyage (1823); Cochrane's and Kane's; Barrow's Travels.

Barrow states that three Hottentots ate a sheep in a day, leaving nothing but the bones, and that ten of them nearly ate an ox in three days. After an unstinted meal of rice, such as is occasionally given to them by the settlers, Australian natives have been known to experience much difficulty in crawling from the scene of their gluttonous exploits to the shelter of the nearest gum-tree.

Comparative Value of Various Aliments.

The most nutritive vegetable foods are those which contain the most gluten (nitrogenous), and starch (or carbonaceous), material.

The following table, by Fromberg, is intended to shew the comparative value of different vegetable products; the gum, starch, and sugar which they contain is taken into account. The highest value is 100.

Beans	100	**Barley**	50
Peas	80	**Potatoes**	45
Oats	75	**Rice**	35
Wheat	70		

A table to shew the relative quantity of azotised and carbonaceous substance in certain plants, with the amount of water (Balfour).

	Wat.	Nit.	Car.	Ash.				
Peas .	16	29	52	3	Nutritive Part	81	Innutritive Part	19
Beans .	14	31	52	3	. .	83	. .	17
Lentils	16	33	48	3	. .	81	. .	19
Oats .	18	11	68	3	. .	79	. .	21
Potatoes	72	2	25	1	. .	27	. .	73
Turnips	89	1	9	1	. .	10	. .	90

It will be seen that the Leguminaceæ yield far more of the tissue-forming material than any other kind of vegetables; next in value are the cereals, oats, wheat, &c.

The next table will afford an example of the national school instruction on these subjects which is advocated by the writer of this essay. It is shewn that potatoes, generally thought to be among the most economical of foods, are really more expensive than bread, and that both are more costly than oatmeal, the chief food of the Scottish peasantry.

One most important consideration in estimating the worth of aliments, the greater or less amount of force expended in digesting different substances, has not been sufficiently noticed by writers on the subject of diet. Think how much of this digestive force is wasted by Irish labourers in the process of digesting, daily, twenty pounds of potatoes! But often they add to their vegetable fare a bowl of easily assimilated milk, and then so large a quantity of potatoes is not required.

Table to shew the cost and quantity of different foods required to supply the daily waste of tissue in a labourer of average size in full work[c].

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[c] Food Department, South Kensington Museum.

	lb.	oz	Av. Cost	s.	d.		lb.	oz	Av. Cost	s.	d.
Wheat Flour .	2	1	. .	0	4½	Peas (dry)	1	5	. .	0	2¼
Oatmeal . .	2	6	. .	0	4½	Beans (dry)	1	5	. .	0	2
Maize . . .	2	9	. .	0	7½	Bread . .	8	13	. .	0	6
Rice	4	13	. .	1	2				. .		
Buck Wheat .	8	10	. .	1	0				. .		
Potatoes . .	20	13	. .	0	7				. .		

From such calculations and analyses may be learned something of the divergence between the popular estimates of nutritive value and the teachings of science.

It is from animal food that the various substances required for the purposes of the body are most abundantly obtained. The muscle or lean part of meat, when dried, yields 70 per cent. of nitrogenous matter, while fat affords nearly 80 per cent. of carbon.

Beef and mutton contain about the same quantity of nitrogenous food; beef, if either, has slightly the advantage. Welsh sheep afford the most nutritious mutton, the next best being the Cheviots and South Downs; Kents and Leicesters are inferior in this respect. In fact the more free and wild the life of an animal the better meat it supplies; when the muscles are fully exercised the whole body is in a healthy state, while in stall-fed cattle, or in sheep that obtain abundant supplies of food without having to earn it by wandering over wide and semi-barren hills, the muscles become coarse and subject to fatty degeneration, and all parts are in a more or less unhealthy condition. The flesh of the domestic hog is very inferior to that of the wild boar in respect to its nutritive qualities and also in flavour. The flesh of hares, wild rabbits, and fowls is almost entirely nitrogenous, and the meat from pigeons yields a higher per-centage of nitrogen than any other kind of food.

Fish afford a considerable quantity of albuminous matter with a large proportion of water. The meat from young animals (veal, lamb, &c.) is much less valuable than that from adults, because their muscles contain a large proportion of gelatine in place of fibrine, and this renders their meat more indigestible and less nutritious. The fat of meat, also cream, butter, sugar, *vinegar*, gum and starch, are simply composed of carbon united in different proportions with water, and they are all capable of being converted into fat by the animal organism; even the nitrogenous principles may be changed to fat in the body, but fat cannot be transformed into fibrine or into any other member of the same group.

That fresh fruits and vegetables are necessary articles of food is proved by the occurrence of scurvy when they are long absent from the diet, and by the fact that they are the best cure for this disease. Farinaceous seeds which contain no vegetable acid are not anti-scorbutic. This is not the place to discuss the question whether the necessary substance supplied to the blood by fresh vegetables is potash, as Professor Garrod maintains. The writer of this essay is inclined to believe that the required substance is a vegetable acid. The climate of extreme northern regions almost forbids the growth of edible plants, and the Laplanders live almost entirely on animal food, yet scurvy is unknown among them; but even among the inhabitants of these latitudes a strong craving exists for vegetable aliment. The writer was told by an officer who served in McClure's expedition, that he had seen an Esquimaux slit up the stomach of a recently-slain reindeer and greedily devour the half-digested contents; he had never, with this exception, seen them eat vegetable food. However, it is said that these people collect and eat certain lichens that grow very sparely upon the rocks.

The higher classes are able to bear deprivation from vegetables better than the poor. From these facts it would appear that custom or necessity may in a great measure inure the constitution against the bad effects of abstinence from this kind of food.

The French in the Crimea found that a salad of dandelion leaves and vinegar protected them from scurvy; such a salad is made tolerably palatable by blanching the leaves of the plant. American soldiers use pickles and sour-krout for anti-scorbutic purposes.

The writer lived for four months on a diet of meat, bread, tea, and water, with the addition of *an orange* daily; during this period he continued in vigorous health and lost no weight, though undergoing considerable mental and muscular labour.

COMPARATIVE DIGESTIBILITY OF FOODS.

This subject was first investigated by Santonini, and soon after him the subject was taken up by Stevens in 1777, who chose the dog and cat as the animals best adapted for his experiments, because they most nearly resembled man in the food upon which they live.

Then Dr. Goss pursued the investigation, and for this he had a peculiar qualification, generally confined to the Ruminantiæ,—the faculty of regurgitating his food at will! After him came Tiedman, who experimented upon the albuminous group; he discovered that albumen was digested in three hours, and gelatine in four hours, but that albumen in a coagulated state was more difficult to digest than either, while fibrine and caseine resisted the action of the gastric juice longer than any of them. Of the vegetable proximate principles, gluten is sooner digested than beef, and starch as quickly as albumen.

Last, but certainly not least of these experimentalists, came Beaumont, whose valuable experiments on Alexis St. Martin enabled him to compile the excellent tables that are given below. St. Martin was a soldier who received an injury in the discharge of his duty that will cause his name to be handed down to posterity for many generations. He was shot in the stomach, and recovered with a large opening in its walls, through which food could be passed directly from the outside or withdrawn, and this peculiar abnormality enabled Dr. Beaumont to complete a series of experiments hitherto unrivalled for their accuracy. It is, however, to be regretted that he did not record the influence which exercise exerts over the process of digestion.

FOODS ARRANGED IN THE ORDER OF THEIR DIGESTIBILITY.

$\left\{\begin{array}{l}\text{Unboiled Albumen}\\ \text{Rice}\\ \text{Tripe}\end{array}\right.$

White Fish
Stale Bread
Beef and Mutton
Game
Potatoes
Preserved Fruit
Pork and Salt Meat
Good Turnips
Red Fish
New Bread
Pastry
Melons, Cucumbers, &c.
Raw Herbs
Coagulated Albumen and Fibrine
Raisins, Cheese, Fat[d], Butter, Walnuts, Almonds, &c.

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[d] The fat of beef is more digestible than that of mutton.

It must be borne in mind that owing to individual idiosyncrasies, some substances which were rapidly digested in the stomach of Alexis St. Martin might not be retained at all in the stomach of another. Striking peculiarities of this kind have been recorded. One case is related of a man upon whom mutton acted like a powerful poison, invariably causing the most serious symptoms, the effect being the same when he had partaken of this meat *without knowing it.* Still the great majority may confidently take the preceding and following classifications as their guide in the selection of digestible foods. St. Martin certainly seems to have been *peculiarly* fortunate in possessing the power of rapidly assimilating roast sucking-pig.

TABLE OF RATE OF DIGESTION.—(BEAUMONT.)

	H.	M.		H.	M.
Boiled Rice . . .	1	0	Raw Oysters . .	2	55
Ditto Tripe . . .	1	0	Boiled Eggs . .	3	0
Ditto Trout . . .	1	30	Beef Steak . . .	3	0
Fried Trout . . .	1	30	Boiled Mutton . .	3	0
Broiled Venison . .	1	45	Roast ditto . . .	3	15
Boiled Milk . . .	2	0	Fried Flounder . .	3	30
Raw Eggs . . .	2	0	Cheese . . .	3	30
			Bread	4	0
Raw Cabbage and Vinegar . . .	2	0	Broiled Veal . .	4	0
Boiled Turkey . .	2	25	Boiled Fowl . .	4	0
Roast ditto . . .	2	20	Roast ditto . . .	4	0
Roast Sucking-pig .	2	30	Boiled Salt Beef . .	4	15
Roast Potatoes . .	2	30	Boiled Pork . .	4	30
Boiled Beef . . .	2	45	Boiled Cabbage . .	4	30
Raw Apples . . .	2	50	Roast Pork . . .	5	15

That cookery materially influences the digestibility of viands is sufficiently apparent from the tables of Beaumont. Not only is this true, but it is also certain that injudicious cooking often deprives animal and other food of its most nutritive qualities.

"The number of inhabitants who may be supported in any country upon its internal produce depends as much upon *the art of cookery* as upon *the art of agriculture*[*]."

The best method of cooking meat, so that all its nutritive qualities may be preserved, is to broil it; roasting is nearly, but not quite, as good; boiling is bad; but the most objectionable mode of preparing meat for the table is to stew it in the ordinary way. Prolonged boiling or stewing hardens and renders difficult of digestion the fibrinous portions of the meat, besides dissolving out the sapid or taste-giving ingredients, the soluble albumen which is contained between the fibres, and various other valuable organic and inorganic substances. When meat is boiled, the best plan, according to Liebig, is to put the meat into water at boiling heat; this temperature should be kept up for a few minutes, and then enough cold water poured into the pot to bring the temperature down to about 165° or 158°, and this degree of heat should be kept up for several hours. In this way the albumen is coagulated on the surface of the meat, and keeps out the water by forming a kind of crust, and thus the soluble matters are retained.

To get the greatest possible quantity of nutritive matter *out* of meat, place it in a saucepan of cold water, and raise the temperature very slowly to the boiling point; but no process of stewing will dissolve the fibre, which constitutes the most valuable part of animal food.

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[*] Count Rumford.

Meat when salted is not only rendered more difficult of digestion, but the brine dissolves and abstracts from the meat some of its most valuable constituents, as will be seen by comparing the following analysis:—

Lean Fresh Beef.	Per cent.	*Salt Beef.*	Per cent.
Water	73.33	Water	70.48
Fat	4.08	Fat	4.37
Nitrog. matters	20.76	Nitrog. matters	18.170
Ash	1.20	Ash	6.165
Various undetermined matters	0.63	Various undetermined matters	0.803
	100.00		100.00[f]

A healthy stomach requires no stimulation by spices and condiments; they induce an abnormal appetite; more food is taken than is required by the system; the stomach is overloaded, and digestion is eventually arrested or seriously impeded. Active exercise in the open air is the great natural remedy for a dainty, delicate appetite and impaired digestive power. Some lines of Armstrong, though not beautiful, are worth quoting here: they convey a useful warning in quaint and amusing language:—

> “Nothing so foreign but the athletic hind
> Can labor into blood—His daily labor thaws
> To friendly chyle the most rebellious mass
> That salt can harden, or the smoke of years;
> Nor does his gorge the luscious bacon rue,
> Nor that which Cestria sends, tenacious paste
> Of solid milk. But ye of softer clay,

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[f] Lancet.

Infirm and delicate! and ye who waste
With pale and bloated sloth the tedious day!
Avoid the stubborn aliment, avoid
The full repast[g]."

"If abused or overtasked, the stomach will most certainly remonstrate, and the remonstrance, if not attended to, may result in a very serious quarrel. To disoblige the stomach is perhaps the most foolish thing that a man can do, and he is certain ere long to repent it bitterly. For the offended organ has avengers, who surely, if not suddenly, make him pay dear for the breach of internal order[h]."

THE RELATION OF FOOD TO MUSCULAR WORK.

We have learned from the chemists that real food, or the nutritive part of alimentary substances, is of two kinds, viz. the nitrogenous group, characterized by the predominance of nitrogen in their composition, and the carbonaceous group, comprising those foods which are almost entirely formed from carbon.

Until quite recently it has been generally held that the nitrogenous foods, being almost identical in composition with muscular tissues, provided the force which is displayed in muscular exertion, by supplying the waste of muscle, through which, it was supposed, the force was evolved. This doctrine was first taught by Liebig.

Lavoisier had performed a series of elaborate experiments to discover the origin of animal heat, and he arrived at the conclusion that it was derived from the

[g] "Art of Preserving Health." [h] "Meditations on Dyspepsia."

combustion of carbon and hydrogen in the lungs; hence the carbonaceous foods have hitherto been looked upon as useful merely to supply fuel for this process of oxygenation; but within the last few years the number of those who doubted the truth of these theories (among whom may be reckoned the writer of this essay) has increased rapidly. Dr. E. Smith, Messrs. Lawes and Gilbert, and others, brought forward facts which have led to the belief that "muscular exertion uses up neither the proper substance of which muscular tissue is composed, nor the albuminous substances consumed in food[i]." Dr. Fick and Dr. Wislicenus, of Zurich, published a paper in the "Philosophical Magazine" for June, 1866, containing an account of an experiment made upon themselves which, as they think, proves that the non-nitrogenous substances are consumed to supply muscular force, rather than the azotised aliments. Curiously enough, Prof. Haughton, of Dublin, had arrived, by a similar experimental process, at a similar result, but though his researches preceded those of Dr. Fick and Dr. Wislicenus, his conclusions were not made public until August, 1868[k].

Three months after the publication of the paper contributed by the latter gentleman, another appeared, in the same journal, in which Dr. Frankland gave the results of further experiments on the subject and his conclusions upon the whole evidence, which has been well summarised as follows by Dr. Henry Power:—"It is agreed on all hands, that muscular power is derived exclusively from the mutual chemical action of the food and atmospheric oxygen; but opinions differ as to whether that food must be first converted into the actual organized substance of the muscle before its oxidation can give rise to mechanical force, or whether it is not also possible that muscular work may be derived from the oxidation of the food which has only arrived at the condition of blood and not of organized tissue. Professor Frankland considers, 1. That muscle is a machine for the conversion of potential energy into mechanical force. 2. That the mechanical force of the muscle is derived chiefly, if not entirely, from an oxidation of matters contained in the blood, and not from an oxidation of muscles themselves. 3. That in man the chief materials used for the production of muscular force are non-nitrogenous, but nitrogenous matters can also be employed for the same purpose, and hence the greatly increased evolution of nitrogen under the influence of a flesh diet, even with no increase of muscular exertion. 4. Like every other part of the body the muscles are constantly being renewed; but this renewal is not perceptibly more rapid during great muscular exertion, than during comparative quiescence. 5. After the supply of sufficient albumenoid matters in the food of man to provide for the necessary renewal of the tissues, the best materials for the production, both of external and internal work, are non-nitrogenous matters, such as oil, fat, sugar, starch, gum, &c. 6. The non-nitrogenous matters of food which find their way into the blood yield up all their potential energy, as actual energy; the nitrogenous matters, on the other hand, leave the body with a portion (one seventh) of their potential energy unexpended. The transformation of potential energy into muscular power is necessarily accompanied by the production of heat within the body, even when the muscular power is exerted externally. This is, doubtless, the chief, and probably the only, source of animal heat."

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[i] M. Sée, *Revue des Cours Scientifiques*, 1866.

[k] "Biennial Retrospect."

As is usual, and as Professor Haughton declares, the truth probably lies between the extreme of M. M. Lavoisier and Liebig on the one hand, and of Drs. Fick and Wislicenus on the other. "A given development of force, expressed in animal heat, muscular work, and mental exertion, may be the effect of several, perhaps many, supposable supplies of digested food, farinaceous, saccharine, fatty, and albuminous[1]."

ATHLETIC TRAINING.

Training is, or rather ought to be, nothing but an unusually careful and systematic obedience to the rules of health for a stated time, that the body generally, and in certain cases one set of muscles particularly, may obtain the maximum strength. The relation that exists between physical education and athletic training is similar to the connection between general and technical education; the one is more comprehensive in its application and object than the other.

Lord Bacon, in his "Advancement of Learning," when alluding to the training of ancient times, says that "the practices are known, but the philosophy which concerneth them is not much inquired into." This is also true of the training systems of our own day. It has arisen amongst us without any relation to physiological science, and it was founded upon the observations and experiments of totally uneducated men, whose deductions were generally vitiated by prejudice, and whose maxims were only preserved by tradition.

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[1] "On the Relation of Food to Work."—Professor Haughton.

The Greeks and Romans were thoroughly alive to the value of a systematic preparation for athletic contests, and many classic writers have given a full account of their method, which Horace thus epitomises:—

> "Qui studet optatim cursu contingere metam
> Multa tulit fecitque puer; sudavit et alsit,
> Abstinuit Venere et Baccho."

No one was allowed to "enter" for a prize at the Olympic games who had not undergone a preparation extending over ten months, during which time the aspirants for the olive crown were restricted to a certain diet, and were daily exercised under the eye of distinguished instructors. In all the larger towns gymnasia were erected. The Athenians, copying from the Lacedæmonians, built three, called respectively Academia, Lyceum, and Cynosarges. Boxing, wrestling, and all the athletic exercises of those days were practised in them, and here also those unrivalled philosophers, Plato and Aristotle, taught the noble youths of Greece and Rome. It was here only that the model for an Apollo could be found, possessing the delicacy of feature and the nobility of expression which indicates intellect and refinement, combined with a form evincing by its beautiful symmetry, perfect health and strength. The dietary of the ancient trainer is diametrically opposed to the regimen of his modern successor. During the first few weeks the athlete of old was fed upon new cheese, boiled grain, and dried figs. After a while animal food was given to him, pork being the most highly esteemed, especially pig's kidney, which was eaten with biscuit, and it was considered necessary, not only to satisfy his appetite, but absolutely to gorge him with food [m].

In the training of boxers it was considered highly desirable to make them fat, with the view of deadening the blows of their adversaries; the fat was expected to serve the purpose of a buffer.

Active purgation and blood-letting inaugurated this pleasant probation, and occasionally during the period of training the athlete was well beaten upon the bare skin with boughs of the prickly rhododendron, that he might learn to endure pain without flinching. The morals of professed athletes were universally condemned by the writers of Galen's time, and we are not, therefore, surprised to learn that this class were then considered a short-lived race of men, as they are in our own day; nor is it very astonishing that the physicians of ancient Greece looked upon this gorging and fattening process with anything but favourable eyes. But all the errors of their diet failed to neutralize the benefits conferred upon them by systematic exercise. After an active day's work the athlete bathed in tepid water; he was then scraped with the strigil, as horses are sometimes treated with a currycomb; soon after he was anointed with oil, and now, having accomplished the arduous labours of the day, he dined.

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[m] Epid. vi.

Training was first practised in England sometime between the years 1720—1740, when pugilism became a national pastime, and was undoubtedly copied from the curriculum of the racing-stable. The celebrated "Gentleman Jackson[a]" reduced it to a system, which was, perhaps, rather in advance of the science of that day, and which is even now faithfully followed by many members of the pugilistic fraternity.

Todd and Bowman, in their "Physiology," give an account of the system pursued by Jackson, and communicated by that worthy to Sir John Sinclair:—

> "The diet is simple—animal food alone; and it is recommended to take very little salt and some vinegar with the food, which prevents thirst and promotes leanness. Vegetables are never given, as carrots, turnips, and potatoes, but bread is allowed, only it must be stale."

Many of the pugilist and pedestrian class have the deepest veneration for the traditional precepts of "Old Joe Ward," whose system is embodied in the following elegant and epigrammatic phrase, well known as "Old Joe Ward's three threes:"—"Three doses of salts, three sweats, three vomits, for three weeks, with victuals three-parts done."

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[a] When the allied sovereigns came to England, after the great continental campaign, Lord Lowther gave them a breakfast at his house in Pall Mall, followed by a series of boxing matches in his drawing-room. The graceful and manly Jackson so delighted the spectators on this occasion, that he was for some time after the hero of the day. Since then pugilists have been foreign to the air of courts—except those of the "county," "sessions," and "assize."

From the time of Figg to that of Broughton, an athlete in training pursued the following course. He rose at 5 A.M., he took gentle exercise till 7, breakfasted, walked, had luncheon at 11, and took his dinner at 1 o'clock, which alternately consisted of stewed veal and boiled fowls. Rusks and wine was ordered for his luncheon; rusks and chocolate for his "tea," at 4 o'clock; and for his supper, at 7, he took rennet milk or milk porridge. When thirsty he might drink wine and water. Between meals jelly was recommended. From supper until bed-time he listened to martial strains of music, and it was hoped that they might help to inspire him with invincible courage. Before going to bed at 9 P.M., he generally bathed his feet in cold spring water, at the same time sponging his chest and shoulders with warm water; but he was warned against the use of soap at any time.

A closer approximation to physiological truth was made when large numbers of gentlemen, on the institution of boat-racing, began to train. Their system may be epitomised as follows:—Up by 6 A.M. Cold bath, followed by the use of hard towels, and perhaps of a flesh-brush. Then a run before breakfast; this meal at 8 A.M. A row on the river from 10 to 12. Dinner at 1 P.M. An hour of rest, and then a brisk walk. Exercise once during the day with dumb-bells or Indian clubs. Tea at 5 P.M., and after a short interval another row. To bed by 10 P.M. The diet of this system is much more liberal, the variety is greater, and the prejudice in favour of "Iron King, all potent water-gruel," and other fabled strength-givers, is now quickly disappearing among boating men.

The method of preparing for athletic contests advocated, and formerly practised, by the author is as follows. It is consistent with the most recent physiological discoveries, and with an extensive experience of athletic training[o]:—

There should be no sudden transition from sedentary occupations to a life of active exercise. The daily amount of work must be gradually increased for two or three weeks before strict training commences, and it would be well if the athlete, during this period, weaned himself from the use of tobacco and fermented liquors. He should also accustom himself to early hours.

The day on which systematic training is to commence having now arrived, the athlete leaves his bed at 7 o'clock, and at once takes his cold bath. His fast, which has been of many hours' duration, should be broken before any work is done. This first meal, and the supper at 7.30 P.M., may consist of toast and butter, eggs, milk, mutton, beef, or chicken, broiled or roasted. The meat must always be well cooked. For men of a bilious habit there is no better drink for the morning and evening meals than tea, not taken too hot or too strong. Others may substitute milk with advantage, while some will prefer coffee, and it need not be refused.

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[o] **Bushy Park, Aug. 11, 1860, Cities of London and Westminster Volunteer Athletic Sports, the writer obtained first prize for the quarter mile race. At the Queen's Westminster Volunteers' Athletic Sports, Crystal Palace, he won the three hurdle races, 1860. Olympic Festival, 1864, he gained the first prize for boxing. Trained and was "stroke" of a "four-oar" crew which rowed against twenty trained crews during the autumns of 1862 and 1863, and defeated them, including Matt. Taylor's watermen's crew (then in training for the Championship of the Thames), but this race was only for a short distance. They thus won the Clydesdale Grand Challenge Cup (holding it for the allotted time against all comers), in 1862 and 1863; the Champion Cup of Scotland, 1863; the Chester Cup, 1862; the Chester Cup, 1863; the Ladies' Plate, Hereford, 1862; and the Stewards' Cup, Derby, 1862. Chester Athletic Sports, 1866, the hurdle race, first prize.**

Tea and coffee, says Lehman, greatly diminish the wear and tear of the system; they oil the machinery, as it were, and check the waste of friction: for those who use them find that during active exercise they require less food; in fact, with a maximum of work to perform and a minimum of food to accomplish it, he will best sustain his vital power who resorts, now and then, to a cup of tea or coffee.

The use of tea has increased most marvellously since 1661, when Pepys wrote in his diary, "I sent for a cup of tea, a China drink, of which I had never drunk before." Among the hardy and laborious backwoodsmen of Nova Scotia and Australasia, whose capacity for enduring fatigue is probably unrivalled, tea has become the universal beverage. In 1862 the Prussian Cabinet issued an order that the brandy served out in the Prussian army should henceforth be replaced by coffee. Each man receives two-fifths of an ounce per day in time of peace, and half-an-ounce in time of war.

Black tea only should be used. The limit as to quantity is about one pint and a-half per diem of fairly strong tea or coffee, but this may be supplemented by as much cold water as is desired. Water will not be taken merely to gratify the palate, but to allay the sensation of thirst, which is the natural indicator of the wants of the system.

Eggs contain much valuable nutriment, azotised and non-azotised, but, as in milk, the predominance of the carbonaceous element renders it necessary that men of a bilious habit should be cautious in the use of them. Hitherto it has been the rule to exclude, almost entirely, the non-azotised foods from training dietaries. The gravity of this error has been explained in previous pages. Many may take both milk and eggs with advantage, at breakfast and supper: these foods are more readily assimilated than most highly carbonaceous substances.

The most digestible food should always be selected, on the principle of economising force, and to secure earlier fitness for active exertion, which may be commenced about two hours after breakfast, when a slow run, row, or other prolonged effort will be well borne, and such should be kept up until one o'clock. By half-past one the man will have rubbed himself dry with hard rough towels, changed his flannels, and will be ready for his dinner. As a rule this meal will consist of either broiled or roast meats, but to secure variety, boiled joints may be allowed occasionally. Venison, game, beef, mutton, rabbits, pigeons, and white sea-fish of every kind, except eels, are permissible. The red-fleshed fishes, as salmon, &c., must be avoided. Pork, veal, lamb, and all salt meats, had better be eschewed.

Vegetables may be eaten freely; cauliflower, spinach, and carrots, are among the most nutritious; but little vegetable food will be required if ripe fruit is taken for desert, and this is strongly recommended. An occasional light pudding need not be forbidden. Either milk or water is the best drink for this meal. Abstain from sweets, pastry, all condiments (except salt), and fermented liquors of every kind. It would be impossible, within the limits of this essay, to prove that alcoholic drinks are not admissible into a training dietary, and to shew that they should be considered to belong exclusively to the *materia medica;* this is, however, a conviction which has been forced upon the writer by much observation and reflection.

Tobacco, again, has found such hosts of ingenious defenders that any attack upon smoking would necessitate a special campaign, which, even if undertaken, might easily end in defeat, for "Providence is on the side of the strongest battalions," and though *magna est veritas,* the truth may have a weak champion.

The best bread is made with flour from which the "dressing" has not been removed; this is better than either bran bread or white bread.

The greatest amount of work should be done between the mid-day and evening meals. For two hours after dinner no exercise more severe than a quiet walk affords should be taken; at the expiration of that time most of the food will have been digested and absorbed into the blood. It is an erroneous but customary practice to get through the greater part of the daily training-work before the principal meal has been taken. We are in the most favourable condition for great muscular effort after this meal has been assimilated; the reinforced blood is then in a condition to replace at once the waste of fuel and tissue that great exertion invariably entails. Nor is the stomach well able to digest a heavy meal soon after exhaustive exercise, because the blood, which is required by the stomach while at work, has been sent "spinning" from the central organs to the muscular extremities. Again, dinner is a meal chiefly composed of nitrogenous food, and it is probable, as Professor Haughton has indicated, "that the muscular qualities developed by the two kinds of food differ considerably from each other. The hunted deer will outrun the leopard in a fair and open chase, because the work supplied to its muscles by the vegetable food is capable of being given out continuously for a long period of time; but in a sudden rush at a near distance, the leopard will infallibly overtake the deer, because its flesh-food stores up in the blood a reserve of force capable of being given out instantaneously in the form of exceedingly rapid muscular action." A few hours after this carnivorous meal, then, is the best time for the most severe effort of the day, while the slower and more continuous exercises should be undertaken during the morning hours.

It will be seen that the best diet for long pedestrian excursions, Alpine climbing, &c., is more carbonaceous and less nitrogenous than would be prescribed for athletic training, which has for its object the accomplishment of some feat occupying, at most, but a few hours.

"The health of the Cornish miners breaks down ultimately, from failure of the action of the heart and its consequences, and not from the affection of the lung called 'miners' phthisis.' The labour of the miner is peculiar, and his food appears to me badly suited to meet its requirements. At the close of a hard day's toil, the weary miner has to climb by vertical ladders through a height of 100 to 200 fathoms before he can reach his cottage, where he naturally looks for his food and sleep. This climbing of the ladders is performed hastily, almost as a gymnastic feat, and throws a heavy strain (amounting from one-eighth to one-quarter of the whole day's work) upon the muscles of the tired miner, during the half-hour or hour that concludes his daily toil. A flesh-fed man (as a Red Indian) would run up the ladders like a cat, using the stores of force already in reserve in his blood; but the Cornish miner, who is fed chiefly upon dough and fat, finds himself greatly distressed by the climbing of the ladders—more so indeed than by the slower labour of quarrying in the mine. His heart, over-stimulated by the rapid exertion of muscular work, beats more and more quickly in its efforts to oxidate the blood in the lungs, and so supply the force required. Local congestion of the lung itself frequently follows, and lays the foundation for the affection, so graphically, though sadly, described by the miner at forty years of age, who tells you that 'his other works are very good, but that he is beginning to leak in the valves.'

"Were I a Cornish miner, and able to afford the luxury, I should train myself for the 'ladder feat' by dining on half-a-pound of rare beefsteak and a glass of ale, from one to two hours before commencing the ascent[p]."

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[p] "Relation of Food to Work."—Haughton.

The kind of exercise and its severity will vary with the object in view. If training for matches in which some distance under two miles is to be run, the course should be traversed twice in the day, morning and afternoon, gradually increasing the speed for the first eight days; after that time the afternoon run should always be "against time." When the match is only for some distance under one mile, the distance may be run three or four times daily, and once "against time." When training for boat-races, the crew should proceed in the cautious and gradual manner recommended to pedestrians, for the first week or ten days, and then endeavour to attain their highest speed by racing over the course each day "against time." The morning row should be a long "grind" at a pace short of the quickest, extending over as great a distance as can be accomplished without distress. An hour or more before the morning pull the crew should take a brisk trot for two miles, at the rate of about one mile in eight minutes.

All artificial methods of inducing secretion from the skin, either by wet sheets, extra clothing, or sudorific drinks, are highly objectionable. Rapid and vigorous exercise is the only healthy mode of reducing fat; thus strength is gained, instead of being lost in the process. The weight to which a man is brought by abundant food and exercise is the weight at which he is best able to contend.

Dr. E. Smith "bases the following statements on his enquiries into the effect of exactly measured degrees of exertion. These shew that, taking the lying posture as the minimum and as the unit of comparison, walking, at the rate of one mile per hour is 1.9; at two miles per hour is 2.76; at three miles 3.22, and at four miles 5.0. The effect of cantering on horseback on a rough horse is 3.16, and of trotting 4.0; of moderate rowing 3.33, and of moderate swimming 4.33. Thus one hour's walking at the rate of four miles per hour would cause as large a consumption of fat as nearly three hours at one mile per hour, and one hour on the tread-wheel is equal to four hours' gentle walking. One hour of lying still while asleep consumes 0.31 oz. of fat, one hour of lying awake in the daytime 0.46. One hour of standing 0.55 oz. One hour of walking at the rate of two miles per hour 1.1 oz., ditto at the rate of three miles per hour 1.6 oz. One hour at the tread-wheel 2.75.

“Hence 1 lb. of fat of the body, in the absence of food, would be consumed by less than six hours at the tread-wheel, by ten hours' walking at three miles per hour, and by fourteen hours' and a-half walking at two miles per hour[q].”

Sleep which is obtained in the early morning hours is not so valuable as that which we get at night. It has been shewn, by careful experiments, that more carbonic acid is expired during the early morning hours, perhaps because our sleep is not then so profound.

Half-past ten should be the athlete's bedtime. Most men require eight hours' sleep when working hard. “Paracelsus,” says Burton[r], “holds it to be the chiefest thing in all physic. Some,” he continues, “cannot sleep for witches and fascinations," and it may be so with some of our present readers; it may possibly have been so with ourselves. But whatever the cause, insufficient sleep is fatal to training.

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[q] “On Obesity,” *Lancet*, May 14, 1864.

[r] “Anatomy of Melancholy.”

No one who engages in athletic contests should require physic, either immediately before, or during, strict training; it is a searching ordeal which none but the healthy should undergo. After the first few days of regular exercise the stomach and other viscera, if sound, will perform their functions effectually without the aid of medicine. A cold bath, or, if possible, a swim in some neighbouring river, should be taken immediately on rising in the morning. In very hot summer weather swimming is one of the best exercises, because it may be vigorously practised without causing the great waste which usually accompanies active exertion in the hottest months. The Latins said of one who could not swim, *nec literas didicit, nec natare.* When the body is exhausted by fatigue, or is rapidly parting with its caloric after being heated, a sudden decrease of temperature is not safe, but adds to the existing depression, and catarrh, or a cold, is one of the smallest evils likely to arise from it.

But if, before plunging into cold water, the body be well warmed by exercise, it is able to spare a little of its heat, and gains in return a stimulating and tonic reaction from the cold immersion.

When, after prolonged exertion, accompanied by free action of the skin, a feeling of chilliness is experienced, a warm rather than a cold bath is indicated.

The period of training should be made as pleasant as possible. It has already been stated that unwilling and reluctant labour is injurious rather than beneficial to the health. Irritability and depression cannot result from good training; when these shew themselves, rely upon it that some grave error has been committed.

"The common expression of being 'in good spirits' means neither more nor less than this—that they are those agreeable feelings which are the result of the different bodily organs acting harmoniously together, and of their functions being well and regularly performed. The condition of which I speak may be regarded as the most perfect state of animal existence, and I doubt whether there is anything in human life that affords to the individual a greater amount than this does of actual enjoyment[a]."

Sir B. Brodie, from whose book the passage is quoted, gives the following general directions for attaining this consummation most devoutly to be wished:—

"A reasonable indulgence, without the abuse, of animal instincts; a life spent in a wholesome atmosphere, and as much as possible in the open air; with a due amount of muscular exercise. Really, there is little more to say[a]."

[a] "Psychological Enquiries."

APPENDIX.

TRAINING systems have, within the last few years, improved considerably, and the record of pedestrian feats appended hereto will shew that this improvement has not been without its due effect upon the strength and endurance of athletes.

PROFESSIONAL PEDESTRIANS.

1845. Thomas Maxfield ran 20 miles in 2 hours minus 17 seconds.

1846. The same man traversed the same distance in 2 hours minus 1½ minutes.

1818. Blumsell ran 10 miles in 58 minutes 56 seconds.

1818. Brooks ran 1 mile in 4 minutes 46 seconds, which was the shortest time up to that date.

1842. "The American Deer," *alias* Jackson, ran 11 miles in 59 minutes 20 seconds.

1844. The great 10 mile race was this year run in America. Two Englishmen went over to contend. One of them, John Barlow, won the first prize (700 dollars), accomplishing the distance in 54 minutes 21 seconds. Steeprock, an Indian, was second; the other Englishman, Greenhalgh, was third; and the celebrated Gildersleeve came in fourth.

1857. Horspool ran 1 mile in 4 minutes 23 seconds.

1864. Richards ran 15 miles in 1 hour 26 minutes 40 seconds.

1863. Deerfoot and Lang ran 12 miles in 1 hour 2 minutes 2½ seconds.

1863. Mills ran 6 miles in 30 minutes 9 seconds.

1863. Lang ran 2 miles in 9 minutes 11 seconds.

1865. Nuttall ran the half mile in the shortest time ever known, 1 minute 55½ seconds.

1865. Richards and Lang ran a dead heat over a mile course in 4 minutes 17½ seconds. This is the best time on record.

AMATEURS.

1804. Captain Barclay ran the mile in 4 minutes 50 seconds.

1863. Captain Machell ran 100 yards in 10¾ seconds.

1868. J. P. Tennent (Wadham College) ran 100 yards in 10⅕ seconds.

1865. C. Guy Pym (War Office) ran a quarter-mile race in 50¼ seconds.

1866. Thornton (Jesus College, Cambridge) ran the half-mile in 2 minutes 2½ seconds.

1867. Hon. G. Pelham accomplished the half-mile in the same time.

1867. R. L. N. Michell ran 2 miles in 10 minutes 1 second.

1869. J. H. Morgan (Trinity College, Oxford) ran 3 miles in 15 minutes 20⅗ seconds.

1867. P. C. Garnett ran 4 miles in 21 minutes 48 seconds.

1868. W. C. Gibbs (Jesus College, Cambridge) 1 mile in 4 minutes 28⅘ seconds.

1868. W. M. Chinnery ran 1 mile in 4 minutes 29⅖ seconds.

1868. Colbeck ran the quarter-mile in 51 seconds.

440 yards is considered the most difficult distance to run well.

To win at average athletic meetings, the quarter mile must be run in less than 1 minute; 100 yards in 12 seconds is very fair time; and the mile should be run in something under 5 minutes. In a 100 yards' race 10 yards is about equivalent to 1 second of time; while 7 or 8 yards is done per second in a quarter-mile race, and about 5 yards per second in a mile race.

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ERRATA.

p. 35, line 8, *for* was *read* were.
p. 44, line 8, *for* exercising *read* exorcising.